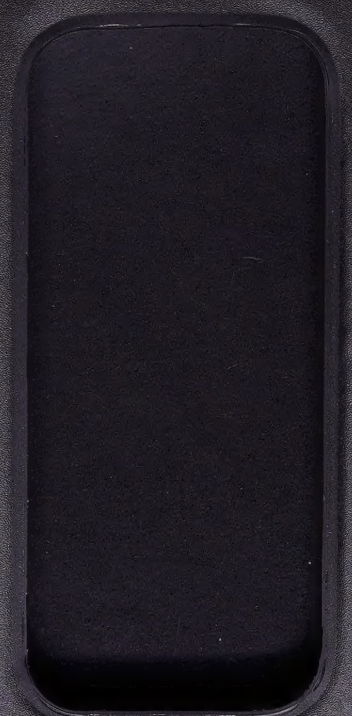
TM-112775-G2

VOLUME 1 -- OPERATOR'S MANUAL

SERIES 656/656A
DISTURBANCE WAVEFORM ANALYZER

DRANETZ



WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements applicable to your installation. Installing, operating, and maintaining this instrument should only be performed by qualified personnel.

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DISTURBANCE WAVEFORM ANALYZER

15 December 1988

(Rev. A: 1 March 1989)
(Rev. B: 1 August 1989)
(Rev. C: 15 December 1989)

See opposite side relative to proprietary rights.

NOTE: Refer to Volume 2 of TM-112775-G2 for Service instructions.

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not applicable

IMPORTANT!

NOTICE: This addendum is intended for anyone operating a 656A Mainframe.

Reading Old 656 Data Files in the New 656A Mainframe

(1) Most 656 Mainframes record data using system software Version 1.3 or 1.4x.

(2) All 656A Mainframes are shipped with Version 2.0x system software.

(3) To read old 656 Mainframe data into the Version 2.0x Mainframes, you must load special system software Version 1.4x (first release is Version 1.43). This software is contained on the 3½-inch disk in the attached vinyl insert.

CAUTION

When reading old 656 data files, DO NOT attempt to load any software other than special Version 1.4x into your Mainframe (other versions are incompatible).

The special Version 1.4x disk should never be used for actual monitoring. To avoid accidently loading this disk when capturing new data, NEVER carry it in the keyboard compartment; instead, store it in the vinyl insert in this manual and leave this instruction sheet attached.

Installing Special Version 1.4x System Software for Reading Old 656 Data Files

(1) If you have any events in memory captured under Version 2.0x that you want to save, download them to disk.

(2) Load the special Version 1.4x disk supplied in the vinyl insert. A message indicates that this disk is incompatible with the resident firmware and that booting it up will erase all events. Since you have saved any desired events, press <*Y*> to continue.

(3) Turn monitoring off.

(4) Bring up a Status Screen to verify that monitoring is off.

(5) Load the old data disk.

(6) When finished analyzing the old data, erase all old data in memory and re-load Version 2.0x system software.

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CAUTION REGARDING FCC COMPLIANCE

This instrument generates, uses, and can radiate radio frequency energy. If is not installed and used in accordance with this Operator's manual, it may cause interference with radio communications. This instrument complies with the limits for a Class "A" computing device pursuant to Subpart J of Part 15 of FCC rules. These rules are designed to provide reasonable protection against such interference when the instrument is operated in a commercial environment. Operating this instrument in a residential area is likely to cause interference, in which case the user, at his or her own expense, is required to take whatever measures necessary to correct the problem.

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FIGURE 1-1. SERIES 656 DISTURBANCE WAVEFORM ANALYZER WITH PC

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VOLUME 1
OPERATOR'S MANUAL

SERIES 656/656A DISTURBANCE WAVEFORM ANALYZER

SECTION I
GENERAL INFORMATION

1.1 SCOPE

The complete manual for the Series 656/656A consists of two volumes. You are reading Volume 1, the Operator's manual, which is divided into three main sections:

I. GENERAL INFORMATION
II. INSTALLATION AND OPERATION
III. OPERATIONAL TESTS

Following Section III are individually tabbed sections detailing the connection, setup, and operation of the available Sensor (Transducer) channel options. Finally, appendices in the back of this manual provide further information on the hardware/software error messages, example waveforms, Setup screens, and suggested Main Channel setups outside of the U.S.

Volume 2, the Service/Maintenance manual, contains four sections (refer to Subsection 1.10 for information on obtaining Volume 2):

IV. THEORY OF OPERATION
V. MAINTENANCE AND CALIBRATION
VI. REPLACEABLE PARTS
VII. SCHEMATICS AND ASSEMBLIES

1.1.1 General Conventions when Reading this Manual

Buttons and switches are capitalized; single keystroke commands and function keys such as *<Return>*, *<Back Space>*, *<Shift>*, *<A>*, and so forth, are italicized and displayed in brackets. Screen displays of printouts and graphs are indented from the margins. **This manual applies to both the Series 656 and its successor, the Series 656A. Because most of the information applies to both units, "656" is the general term used in this manual. Any information specific to just the 656A is described as "656A" rather than "656".**

1.2 INTRODUCTION

Congratulations on your purchase of the Dranetz 656 Disturbance Waveform Analyzer. We are confident you will be delighted with the unit's unique analyzing capabilities, as well as its ability to download events to a disk for permanent storage and later recall. The 656 is a powerful, self-contained, portable instrument that captures, records, analyzes, and displays AC and DC power line disturbances on four power acquisition channels. With available options installed, the 656 also monitors radiated and conducted RF (radio frequency) energy levels and environmental temperature and humidity changes using its Sensor (transducer) channels. The 656A monitors current as well as voltage.

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1.2.1 Overview of Operation

The 656 is designed for easy operation. All selections and entries are prompted by the CRT, and the Operator is never more than a keystroke away from a "Help" screen. This lets you run the 656 without having to continually refer to this manual for instructions.

Main Input Channel Monitoring
There are four Main input channels (A, B, C, and D). Each Main input channel can monitor AC voltage, neutral-to-ground voltage, or DC voltage on either a low (0 to 60 V rms) or high (0 to 600 V rms) range. With the 656A, channels B, C, and D can also monitor current on ranges of 0 to 5, 0 to 30, 0 to 300, or 0 to 3000 A rms. **NOTE**: Most example screens in this manual illustrate voltage displays, however, be aware that current displays with "Arms" and "Apeak" replacing "Vrms" and "Vpeak" are possible with the 656A. **WARNING**: Before attempting Main input channel monitoring, ground channel A to a verified safety ground (using the grounding lug on the 656A or screw terminal on the 656).

Sensor Channel Monitoring
The Sensor channels are used for environmental monitoring. Options are available to monitor environmental temperature and humidity changes, conducted RF (radio frequency) energy, and radiated RF energy.

Primary Synchronization
By convention, channel A is the primary synchronization channel. If a synchronization signal is not available on channel A, synchronization automatically switches to the next active channel (B then C then D). **Note**: The synchronization signal should be referenced to a voltage waveform, not a current waveform.

Capturing the Initial Reference Readings
When you turn on the 656, you'll hear beeps indicating that the power on event, Main channel waveform, frequency, and Sensor channel readings have been captured. If you want to update the reference waveform at any time, or if you want to get a "snapshot" of the current monitoring conditions, use the following sequence:

1. From the Main Menu, press *<4>* to go into the Monitoring Functions Menu and then press *<1>* to go into Main Channel Setups. The active setup is displayed.

2. Press *<A>* to reactivate this setup. You'll then hear beeps indicating that new waveform, frequency, and sensor readings have been captured.

Event Recording
Other than the standard events recorded when the 656 is first turned on, events are also recorded with any of the following occurrences:

- When the monitored waveform for a channel deviates by more than the programmed RMS sensitivity from the last cycle of the last event for that channel.

- When an impulse on a channel exceeds the impulse sensitivity threshold (V peak or A peak) for that channel.

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- When the Synchronization channel's frequency (averaged over 20 cycles) changes from the last recorded frequency by more than the programmed sensitivity for that channel.

- When a Sensor channel's input changes from the previous reading by more than the programmed sensitivity for that channel.

The event cycle ends when the line, frequency, and Sensor channel inputs all stabilize.

NOTE

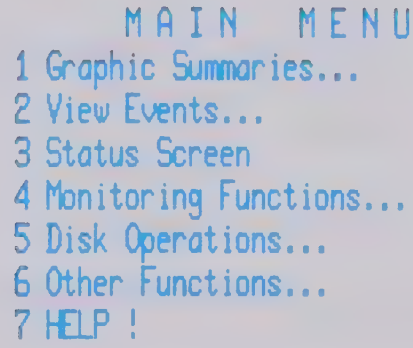
RMS voltages and currents are calculated on a single cycle basis from one positive zero crossing to the next positive zero crossing.

Diagnosing Power Problems

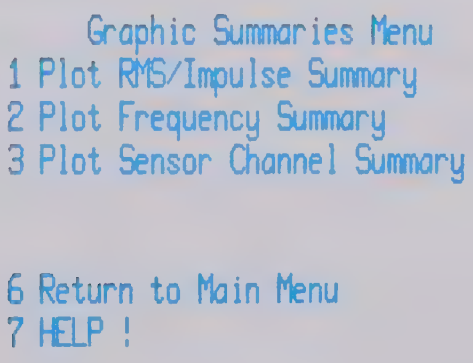
Refer to Section II of this manual for detailed instructions of the following menus. These menus are provided as an example to get you acquainted with diagnosing power problems.

Power problems can be diagnosed as follows:

1. Starting at the 656 Main Menu:



2. Press <*1*> for the Graphics Summaries Menu:


Graphic Summaries Menu
1 Plot RMS/Impulse Summary
2 Plot Frequency Summary
3 Plot Sensor Channel Summary
6 Return to Main Menu
7 HELP !

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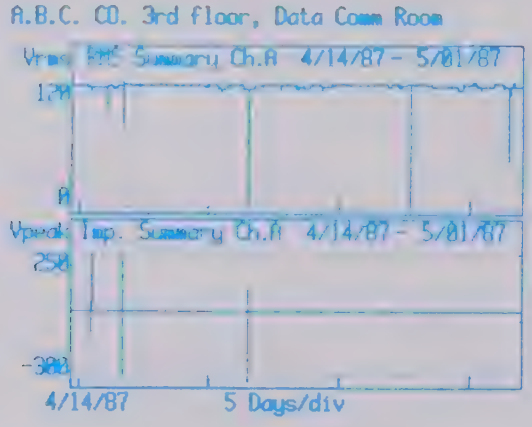
3. Press <*1*> for the Plot RMS/Impulse Summary Menu:

```
        Plot RMS/Impulse Menu
1 Channel to be Plotted: A
2 Plot Multiple Days...
3 Plot Any Day by Hour...
4 Plot Previous 24 Hours
5 Plot Previous Hour
6 Return to Previous Menu
7 HELP !
```

4. Pressing <*1*> at this point alternates the channel from "A" to "B" to "C" to "D" to "A", and so forth. Once the proper channel is displayed, you could press <*2*>, <*3*>, <*4*>, or <*5*>, depending on the time span you want to examine. For example: If you pressed <*2*> to plot multiple days and then entered a starting time and an ending date, an RMS/Impulse plot of events in memory between these dates is displayed:



The above display illustrates rms voltage changes (top) and impulses (bottom) recorded between 4/14/87 and 5/1/87.

5. If desired, you could press <*T*> for a description of the display:

```
        Ch. A RMS/Impulse Plot Summary

A.B.C. CO. 3rd floor, Data Comm Room

Start on Event # 1      End on Event # 206
     Start Time:  4/14/87  17:10
     End Time:    5/01/87  23:59

          Worst RMS Events
   Max Value = 123.1 Vrms   Event # 50
   Min Value = 0.0 Vrms     Event # 142

        # Impulse Events = 4
Worst Pos Value = 252 Vpeak   Event # 38
Worst Neg Value = -324 Vpeak  Event # 88
```

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The previous display describes the RMS/Impulse Plot summary. Note: The starting time is 5:10 p.m. because this is when the first event was recorded on 4/14/87.

6. Once you have a general idea of the events which have occurred, you can narrow the interval to be searched or you can view specific event numbers (refer to Section II).

NOTE: If current was recorded using a 656A, "Arms" and "Apeak" would replace "Vrms" and Vpeak".

1.2.2 Using the Keyboard, Touch-Screen, and Zoom-Box

It is assumed you know how to use a typewriter style keyboard.

The touch-screen lets you quickly make screen selections by applying gentle pressure with your index finger. When you slide your finger up and down the screen, the area beneath your fingertip highlights. If there are several selections on a line, each highlights as you move your finger across the screen. A function is selected when you release your finger from a highlighted area. If you feel comfortable using the touch-screen, use it. If you feel more comfortable using the keyboard to make selections and entries, use it instead (you are prompted on the screen with the corresponding key to enter).

The "zoom-box" feature lets you enlarge any portion of a displayed waveform. You move the zoom-box around by placing your index finger on the corner of the box you wish to move in or out, and then sliding your finger slowly across the touch-screen. The two adjacent sides of the box move with your finger. When the box is at its new position, lift your finger from the screen and the new box remains in place. Again, if you feel comfortable using the zoom-box, use it. If you are more comfortable using the keyboard to move the zoom-box around, the quick-reference card in this manual illustrates the keys to use to move the zoom-box.

1.3 FEATURES

The 656 operates on microprocessor based hardware, is self-contained and portable, and has the following features:

- Two MC68000 microprocessors: 16/32-bit architecture
- Menu prompts with available "Help" screens
- Four Main input channels for graphical disturbance recording
- Eight Sensor input channels for environmental monitoring (Optional)
- Two RS-232C compatible serial ports
- High-resolution CRT with touch-screen overlay
- Built-in high-resolution thermal printer

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- Dual 3½ inch disk drives
- Built-in real-time clock with 10mS resolution
- Zoom feature for enlarging any portions of waveforms and digital measurements
- Non-volatile memory of ½ Mbyte for long-term monitoring and data storage

1.3.1 Distinctive Operation

Most data analyzers print events on paper as they occur, often resulting in a lot of wasted paper. The 656 is distinct in that it internally stores large amounts of event data without necessarily printing or displaying it. When you want a graphic summary of the events that have occurred, you can go through the Graphic Summaries Menu to display all of the events or only the ones you want. You can also go to the View Events Menu to view a particular event. If you want a paper printout (for reports, analysis, and so forth), the internal or an external printer can print a copy of the individual event or a graphic summary of a series of events. You can then use this information for fast and easy solutions to your most intricate power problems.

1.4 APPLICATIONS AND PURPOSE

The 656 captures, records, stores, analyzes, and displays power line disturbances affecting reliable operation of sensitive electronic, computer-based equipment. With its options installed, you can also capture, record, store, analyze, and display environmental temperature and humidity changes, conducted radio frequency interference, and radiated radio frequency interference.

Once you have captured the disturbances and changes, you can perform broad (macro) or detailed (micro) event analysis. For broad analysis you can display a series of related events. For detailed analysis you can display a high-resolution view of an individual event.

You preset the 656 to record events exceeding your threshold criteria. Once recorded, these disturbances can be analyzed on screen, saved to a disk, printed for hard copy analysis, transmitted to another 656 through a modem or direct RS-232C connection, and analyzed on a PC using PC software such as Dranetz 656-OS-2001.

1.5 GENERAL OVERALL DESCRIPTION

Front and rear panel views of the 656 and 656A are illustrated in Figures 1-2 and 1-3 (both units are identical from the front panel).

Subsections 1.5.1 and 1.5.2 list the visible parts of the front and rear panels. (For illustrative purposes, the keyboard is considered part of the front panel.) Subsections 1.6 through 1.6.10 describe the main sections of the 656, including the connecting cables.

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FIGURE 1-2. SERIES 656/656A FRONT PANEL AND CURRENT PROBE†

†The current probe sitting on top is an option with the 656A.

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FIGURE 1-3. SERIES 656/656A REAR PANEL

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1.5.1 Front Panel

The front panel illustrated in Figure 1-2 contains the following sections:

- 5" high-resolution CRT with touch-screen overlay
- SETUP knob for default setup at power-on (second knob reserved for future use)
- Two 3½ disk drives
  - Events and setups are stored and retrieved on the disk in the left disk drive
  - Right disk drive is used for loading the System Disk and copying disks (Left and right is from your perspective when looking at the Mainframe.)
- Thermal Printer
- PAPER FEED button
- CANCEL printout in progress button
- Folding, typewriter style keyboard
- Diskette storage compartment

1.5.2 Rear Panel

The rear panel illustrated in Figure 1-3 contains the following sections:

- Power supply fan
- ON/OFF switch
- "BATTERY CHARGED" and "BATTERY OPERATING" LEDs
- AC power cord receptacle
- Main Port (25-pin RS-232C female serial port)
- Auxiliary Port (9-pin RS-232C female serial port)
- Four Main input channels for power disturbance monitoring (the 656A has jacks in place of screw terminals)
- Eight optional Sensor input channels for environmental monitoring
- Fuse

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1.6 INPUT AND OUTPUT SECTIONS

The following subsections contain information on the input and output portions of the 656.

1.6.1 Thermal Printer

CAUTION

Never allow the 656 printer to operate without paper because doing so could damage the print head.

The 656 thermal printer provides paper printouts of screen displays. You can get a printout of any screen at any time by holding down <*Control*> and pressing <*P*>.

1.6.1.1 Reading the Display

The printer's display is the same orientation as the screen display: left to right across the page.

1.6.1.2 Changing a Roll of Thermal Paper

1. Stand the Mainframe in its operating position on a flat surface with its keyboard folded down.
2. Tear off any remaining paper from the printer and press and hold the PAPER FEED button to spew out any paper left between the print head.
3. Open the printer compartment by pressing the button on the door. The chassis will slide out.
4. Lift the empty spool up from the U-shaped slots.
5. Pry off one of the plastic retainers on either end of the shaft and slide it out of the empty spool.
6. Reinsert the shaft in a new roll of paper and reattach the retaining clip.
7. Install the new roll into the U-shaped slots, oriented so the paper feeds from the back of the roll going up.
8. Using scissors, make a straight cut across the leading edge of the paper.
9. Feed the paper about a ¼ inch into the lower "in" feed slot (just above the roll).

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10. While gently working the paper into the printer, press and hold the PAPER FEED button until the paper goes through the print head and reappears at the "out" feed slot just below the tear-bar (¾ of an inch above the "in" slot). MAKE SURE THE PAPER FEEDS EVENLY.

11. Push the printer chassis in until it locks. The paper should be visible just below the tear-bar. If it's not, press and hold the PAPER FEED button until it comes into view.

1.6.1.3 Paper Take-Up Feature

If you don't want the printed paper to hang from the slot, you can use the automatic take-up feature to store the paper internally.

1. Press and hold the PAPER FEED button until there are about 8 to 10 inches of paper hanging.

2. Press the printer compartment button and the compartment will slide out.

3. Push in on the top of the door so that it flips up, exposing the paper take-up spool. Remove the spool.

4. Using scissors, make two cuts on the leading edge of the paper to form a slight point.

5. Insert the pointed end of the paper into the groove on the paper spool. Wind the paper toward you several times (like loading 35mm film) until its slack is taken up. (The winding is clockwise when viewed from the left.)

6. Reinsert the spool into its slots.

7. Close the door and push in the printer chassis. Press the PAPER FEED button to make sure the paper advances properly.

1.6.1.4 Reordering Thermal Paper

Thermal paper for the 656 thermal printer may be ordered from your authorized Dranetz representative or directly from Dranetz (P/N 110888C) by calling or writing:

Dranetz Technologies, Inc.
1000 New Durham Road
P.O. Box 4019
Edison, NJ 08818-4019
Attention: Order Entry

Tel: (201) 287-3680
FAX: (201) 287-8627
TWX: (710) 997-9553
Telex: 499-7808
Cable: DRANETZ

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CAUTION

Using thermal paper other than that supplied by Dranetz Technologies, Inc. or its authorized representatives may damage the print head.

1.6.2 CRT with Touch-Screen

The glare resistant CRT provides menu displays for guiding you through operations, lists "Help" screens describing menu choices and what they mean, and displays high-resolution pictures of waveforms and text displays. When a waveform is displayed, the CRT also lets you zoom in any portion of a waveform to take a closer look at it.

1.6.3 Dual Disk Drives

The 656 has two 3.5 inch disk drives. The left drive (when facing the unit) is used for saving and loading system setups, recorded events, or both. The right drive is used for loading the System Disk and for copying disks.

1.6.3.1 Disks

The 656 is shipped with one blank (unformatted) disk and two system disks (one labelled "656 Program" and the other labelled "656 Backup"). For best results, always use high quality, double sided, double density disks. If you need additional disks, see Subsection 1.10.

To write protect a disk, open the tab at the bottom corner of the disk. When the slot is open, you cannot write to the disk. To write to a disk, close the slot.

1.6.3.2 Cleaning the Disk Drives

After extended use, the disk drives become dirty and require cleaning. Only use a quality 3.5 inch disk drive cleaning kit and follow its directions for preparing the cleaning disk. To clean the left disk drive, follow the procedure for initializing a disk (Subsection 2.8.5), but use the cleaning disk and ignore the error messages that appear on the screen. To clean the right disk drive, insert the disk and attempt to use the cleaning disk as if it was a 656 System Disk.

1.6.4 Keyboard

The folding typewriter style keyboard lets you do everything you can do on the touch-screen, in addition to entering data and typing comments. Descriptions of these keys and how they affect 656 operation are given in the applicable subsections in this manual.

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1.6.5 Power Supply

The Power Supply module in the rear of the Mainframe allows operation within 90 to 250 V rms at 50 to 60 Hz. The power cord attaches to the power cord receptacle. The module is cooled by an internal fan and an ON/OFF rocker switch turns the 656 on and off.

1.6.5.1 Battery Pack

When the 656 is on, the "BATTERY CHARGED" LED indicates that the internal UPS (Uninterrupted Power Supply) battery pack is fully charged. If line voltage fails, the "BATTERY OPERATING" LED lights to indicate UPS operation. The UPS maintains operation for about 15 minutes if power is temporarily lost.

1.6.6 Communication Ports

The rear panel contains two serial communication ports: Main port and an Auxiliary port.

1.6.6.1 Main Port Description

The Main port is a female, 25-pin, RS-232C serial port with selectable baud rates (1200 to 9600). The port lets the 656 communicate with another 656 or a personal computer through direct connection for up to 50 feet, or through a modem for greater distances.

1.6.6.2 Cables for Main Port Connections

Connecting the 656 to another 656 or to an external modem is made through a null-modem cable (113446-G1). Table 1-1 provides the descriptions of the Main port pinouts and Figure 1-4 illustrates the lines running between the cable connectors.

The 656 can also be set up to communicate with a personal computer. Dranetz 656-OS-2001 Graphical and Harmonics Analysis Software is available to facilitate this communication. Refer to TM-113522 for more information on this software.

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TABLE 1-1. MAIN PORT PINOUTS

Pin Name	Function	Direction	Description of Operation
1 GND	Protective Ground	Not Applicable	Shield of interface cable should be connected to this pin which is tied to the internal frame ground.
2 RCV	Receive Data	Input	656 receives serial data input from the connected device.
3 XMT	Transmit Data	Output	656 sends output to the connected device.
7 GND	Signal Ground	Not Applicable	Internally connected to pin 1.

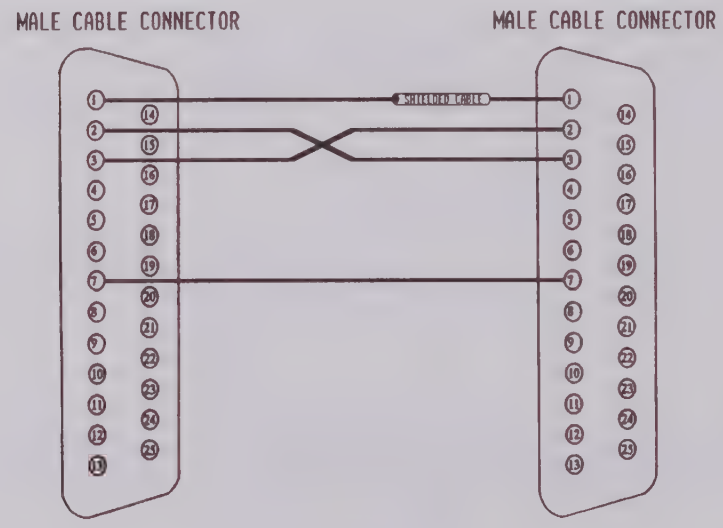

FIGURE 1-4. NULL-MODEM CABLE PINOUTS

1.6.6.3 Auxiliary Port Description

The Auxiliary port is a female, 9-pin, RS-232C serial port fixed at 9600 baud. The Auxiliary port lets the 656 communicate with an external printer or other output device.

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1.6.6.4 Cables for Auxiliary Port Connections

Connection of the 656 to a remote printer is made through an Auxiliary Port cable (113447-G1). Table 1-2 provides the descriptions of the Main port pinouts and Figure 1-5 illustrates the lines running between the cable connectors. If you have Dranetz Data Management software, you can use a personal computer as an output device through cable 113448-G1 (refer to your Dranetz Data Management software manual for more on this).

TABLE 1-2. AUXILIARY PORT PINOUTS

Pin Name	Function	Direction	Description of Operation
1 GND	Protective Signal Ground	Not Applicable	Shield of interface cable should be connected to this pin which is tied to the internal frame ground.
2 RCV	Receive Data	Input	656 receives serial data input from the connected device. DTR must be TRUE for data to be recognized.
3 XMT	Transmit Data	Output	656 sends output to the connected device provided DTR is TRUE.
4 DTR	Data Terminal Ready	Input	This signal must be TRUE for the 656 to acknowledge the presence of a connected device. A FALSE state immediately disables the data transfer.

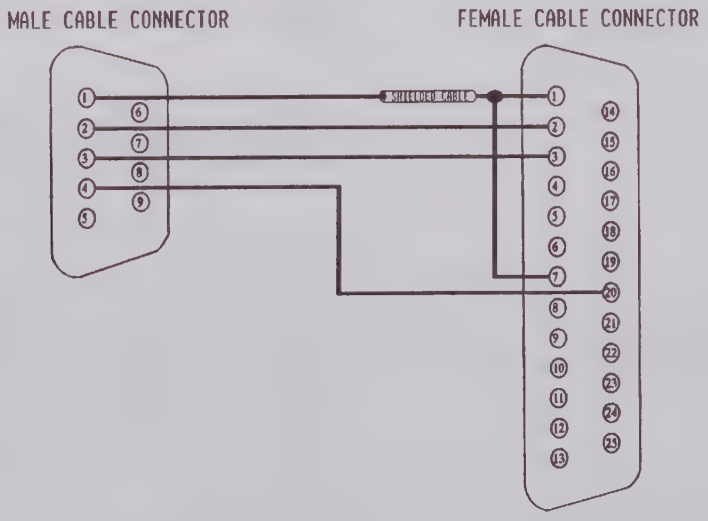

FIGURE 1-5. AUXILIARY PORT CABLE PINOUTS

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1.6.7 Main Input Channels for Power Line Disturbance Monitoring

Refer to Table 1-3 for technical specifications. Four rear panel voltage inputs (and 3 rear panel current inputs for the 656A only) allow the 656 to analyze synchronous, multiphase AC power lines of up to 600 V rms and 300 A rms (3000 A rms if using the TR-2015A current probe and CT Termination Box).

WARNING

To avoid serious injury, only use the safety plugs provided with the instrument.

Below is an illustration of the four Main input channels:

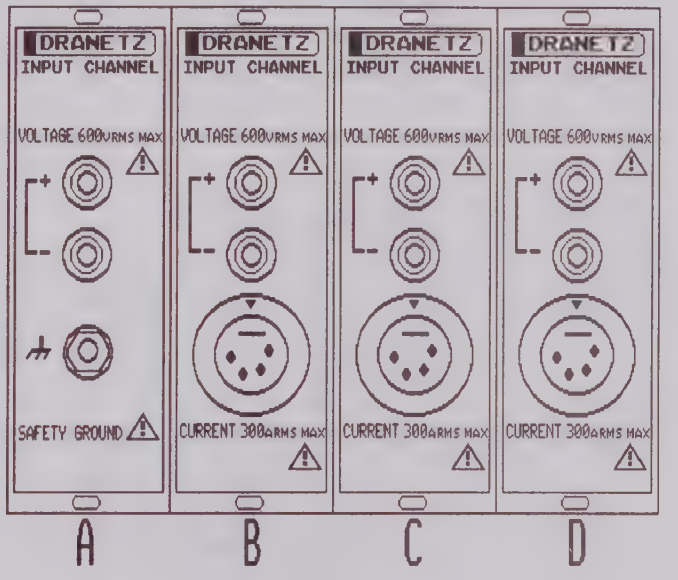

FIGURE 1-6A. MAIN INPUT CHANNELS (656A)

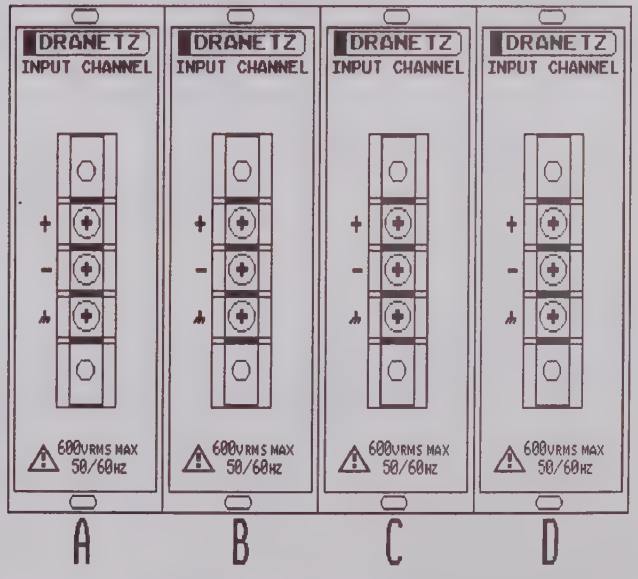

FIGURE 1-6B. MAIN INPUT CHANNELS (656)

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1.6.8 Sensor Input Channels for Environmental Monitoring

A single 16-position removeable terminal block is provided for wiring up to eight Sensor input channels. The terminal block is labelled "Transducer Channels", although the menus and other references commonly refer to "Sensor channels". It is much easier to wire this connector before inserting it into the Mainframe than it is once it's in the Mainframe. The channels applying to each available Sensor input channel option are illustrated in Figure 1-7.

CAUTION

Connect a supplied jumper between the "+" and "−" terminals of each channel that's not being used.

Note: All eight Sensor channels are factory preset for 0-10V input. To change any input to 0-40mA, contact Dranetz Customer Service Department for instructions (see Subsection 1.11).

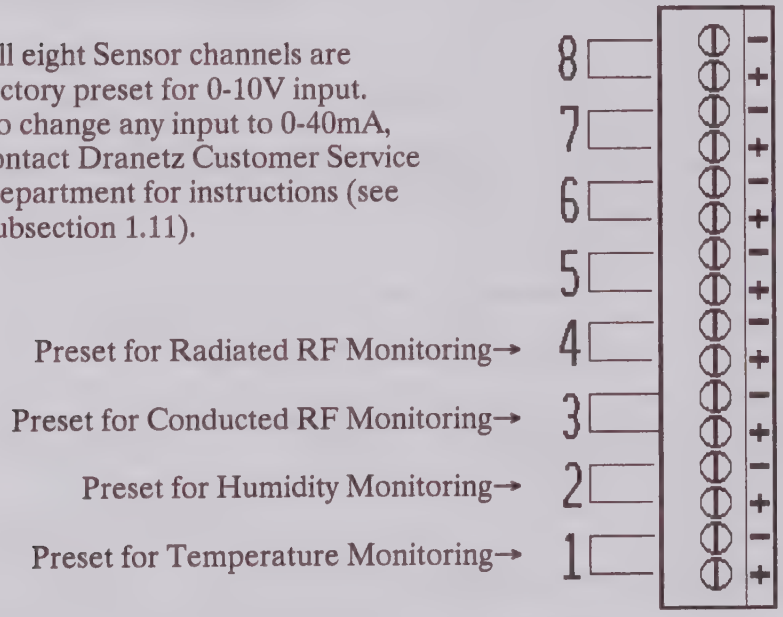

FIGURE 1-7. SENSOR INPUT CHANNEL STRIP WITH CORRESPONDING SENSOR OPTIONS

1.6.9 Real-Time Clock

A crystal controlled real-time clock (±25 PPM stability) is built into the Mainframe. The clock is battery backed with an estimated 10-year life. Time appears in 24-hour military format (hours, minutes, seconds, tens of milliseconds) with a 10mS resolution.

1.6.10 Beeper

The 656 produces a beep at power-on and whenever a new event occurs. The beeper can be turned on and off under the Other Functions Menu.

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1.7 REMOTE OPERATION

Event data and system setups can be transferred between two 656 Mainframes, or, using applicable software, between a 656 and a personal computer. Event data and system setups are transmitted over the telephone lines using a modem at each site. Event data and system setups can also be transmitted through an RS-232C line between two 656s if they are within 50 feet. In order to do this, the 656 that's waiting to receive event data and setups must be put in the "Non Modem Receive" mode. In this mode, it waits to be called while still continuing its monitoring.

1.7.1 Data Transmission over Telephone Lines

Using an internal or external modem (the 656 supports the Hayes 1200 Smartmodem), the 656 can transfer data over a telephone line to another 656 or to a personal computer.

1.7.1.1 656 Data Transfer to a Personal Computer

Using the Dranetz 656-OS-2001 Graphical and Harmonic Analysis Software Package, data can be transferred over telephone lines to a personal computer.

NOTE

You can also use a direct connect RS-232C cable for up to 50 feet of connection between the 656 and a personal computer or other 656.

1.7.1.2 Main and Auxiliary Port Baud Rates

Data is transmitted through the Main Port to another 656, modem, or personal computer at between 1200 and 9600 baud with 8 data bits, 1 start-bit, 1 stop-bit, and no parity or handshaking.

Data is transmitted through the Auxiliary Port to a printer or other output device at 9600 baud with 8 data bits, 1 start-bit, 1 stop-bit, and no parity or handshaking. Printers which are known to be compatible with the 656 are the:

- Hewlett-Packard Thinkjet
- Epson LX-800
- Apple Imagewriter
- Okidata ML-192

Note: If you are using one of these printers, refer to its manual for the proper dip switch selections.

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1.8 SPECIFICATION SUMMARY

Table 1-3 summarizes the specifications of the 656.

TABLE 1-3. 656/656A SPECIFICATIONS

OPERATION	Menu-driven with accessible "Help" screens
DIMENSIONS	
Package	Rugged, portable case with multiposition handle
Size	6" high by 19" wide by 21" deep (15 x 48 x 53 cm)
Weight	45 pounds (20.25 kg)
ENVIRONMENTAL SPECIFICATIONS	
Operating	10° to 40°C (50° to 104°F)
Storage	−20° to 55°C (−4° to 131°F)
Humidity	10% to 90% (non-condensing)
TIME CLOCK	Crystal controlled, ±25 PPM stability, 10mS resolution. Lists time in HH:MM:SS:ss format and date in MM:DD:YY format, including day of week. Accurate to within 2 seconds per day.
MAIN INPUT CHANNELS	Four 2-wire differential Main input channels for power line monitoring.
AC Voltage Ranges	0 to 60 V rms (low range) 0 to 600 V rms (high range)
AC Current Ranges (656A ONLY)	0 to 5 A rms, 0 to 30 A rms, 0 to 300 A rms, and 0 to 3000 A rms
Frequency	45 to 65 Hz
Input Impedance	40 MΩ (voltage) 120 Ω (current)
Accuracy	Voltage: ±1% reading ±0.2% full scale (6V to 600V) Current: ±2% reading ±0.2% full scale (6A to 300A)
Resolution	Voltage: 0.1V (0 to 72V low range); 1V (0 to 600V high range) Current: 1A resolution using 300A current probe (TR-2019A)
Sampling Rate	7.2 kHz
Impulse Voltage Range	2.4 to 6120 V pk
Impulse Current Range (656A only; Probe Dependent)	TR-2015A (0.2 to 18200 A pk); TR-2019A (0.2 to 1820 A pk); TR-2021A (0.2 to 182 A pk); CT Termination Box (0.2 to 30.5 A pk)
Impulse Duration	>1μS
Impulse Sampling Rate	1.8432 MHz
Impulse Accuracy	±10% reading ±1% full scale
Impulse Resolution	(upper ranges) 12V at or below 1536V, 24V above 1536V (lower ranges) 1.2V at or below 153.6V, 2.4V above 153.6V (upper ranges) 12A at or below 1536A, 24A above 1536A w/300A probe (lower ranges) 1.2A at or below 153.6A, 2.4A above 153.6A w/300A probe
OPTIONAL SENSOR INPUT CHANNELS FOR ENVIRONMENTAL MONITORING	Eight input channels, configurable as current or voltage inputs (fused)
DC Input Ranges	0 to 10 V DC (voltage input) or 0 to 40 mA DC (current input)
Input Impedance	>2.0 MΩ (voltage); 250 Ω (current loop)
Sampling Rate	12.5 Hz
Accuracy	±0.5% reading ±0.2% full scale
MEMORY	512 Kbytes of non-volatile event RAM; 128 Kbytes of program RAM; 64 Kbytes of system RAM; 64 Kbytes of system ROM
Disk Drives	Dual 3½ inch, double sided, double density disks.
PRINTER	High-resolution graphics printer, 256 dots/line, automatic paper take-up
Paper	Thermal, 256 dots per line
USER INTERFACES	
Screen	5-inch diagonal monochrome CRT with a touch-sensitive overlay
Keyboard	Full travel, folding, typewriter style, alphanumeric
Serial Ports	One 9-pin Female (DCE) RS-232C port One 25-pin Female (DCE) RS-232C port
OPTIONAL MODEM	2400 bps internal (Hayes compatible)
POWER REQUIREMENTS	90 to 250 V rms, 50/60/400 Hz, 100 watts typically
UNINTERRUPTABLE POWER SUPPLY (UPS)	Provides at least 15 minutes of uninterrupted operation if power goes out. (Six to ten hours is the typical recharge time for the UPS.)

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1.9 STANDARD ACCESSORIES

Part Number†	Quantity	Description
TM-112775-G2 Vol. 1	1	Series 656/656A Operator's Manual
110888-G1	1	Roll of Thermal Paper
110727-G3	1	Shielded AC Line Cord
114012-G1 (656A ONLY)	1 Set	Measurement Cable Kit
105385-G1	1	Program Diskette
113227-G1	1	Event Diskette

1.10 OPTIONAL ACCESSORIES

See step (3) of Subsection 1.11 for information on obtaining the Service/Maintenance manual (Volume 2) listed below. To purchase any of the other options, contact:

Dranetz Technologies, Inc.
1000 New Durham Road
P.O. Box 4019
Edison, New Jersey 08818-4019
Attn: Order Entry

Tel: (201) 287-3680
FAX: (201) 287-8627
TWX: (201) 977-9553
Telex: 499-7808
Cable: DRANETZ

Part Number†	Quantity Required	Description
TM-112775-G2 Vol. 2	1	Series 656/656A Service Manual
Computer Software		
656-OS-2001	1	Graphical Harmonic and Analysis Software Package
Accessories for Environmental Monitoring		
112935-G1	1	656-PA-1001 8-Channel Transducer Board
656-XD-1001‡	1	Temperature & Humidity Monitor (Included is a 1' signal cable, 113802-G1, and an attached 9' extension cable)
113804-G1	1	90' extension cable for 656-XD-1001

†Part numbers are Dranetz part numbers unless indicated otherwise.

‡Requires 656-PA-1001 installed.

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Part Number	Quantity Required	Description
656-XD-1002†	1	Conducted RF Monitor
(Included is a 1' signal cable, 113814-G1, and an attached 9' extension cable)		
656-XD-1003†	1	Radiated RF Monitor
(Included is a 1' signal cable, 113814-G1, and an attached 9' extension cable)		
Current Probes and CT Termination Box		
TR-2019A (656A Only)	1-3	TR-2019A, 300A current probe
TR-2021A (656A Only)	1-3	TR-2021A, 30A current probe
110639-G1	1-3	TR-2015A, 1000/2000/3000A current probe (when ordered, includes 110635-G2, the CT Termination Box)
110635-G2 (656A Only)	1-3	0-5A Isolated CT Termination Box
Miscellaneous		
112864	1	656 User Kit: shipping container, case of paper, two boxes of disks, and a 1-day training course
112893	1	Soft carrying case
112894	1	Reusable hard shipping container
113070	Up to you	Box of 10 3.5" disks
2400 Baud Int. Modem	1	Hayes compatible internal modem
TR-2019A (656A Only)	1-3	TR-2019A, 300A current probe
TR-2021A (656A Only)	1-3	TR-2021A, 30A current probe
110639-G1	1-3	TR-2015A, 1000/2000/3000A current probe (when ordered, includes 110635-G2, the CT Termination Box)
110635-G2 (656A Only)	1-3	0-5A Isolated CT Termination Box

†Requires 656-PA-1001 installed.

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Part Number	Quantity Required	Description
113806 (656 Only)	1 Set	4-Channel cable set
113807 (656 Only)	1 Set	Universal cable set
113446-G1	1	Main Port Null-Modem Cable (male 25-pin connectors)
113447-G1	1	Auxiliary Port Cable (male 9- and 25-pin connectors)
113448-G1	1	Auxiliary Port Cable (one male 9-pin and female 25-pin connector)
113449-G1	1	Main Port Cable (one male and female 25-pin connector)

1.11 FACTORY REPAIR

When factory repair is required, proceed as follows:

1. Contact Dranetz Customer Service Department to obtain an authorization number for factory repair:

   Tel: (201) 287-3680 Telex: 499-7808
   FAX: (201) 248-9240 Cable: DRANETZ
   TWX: (201) 997-9553

2. Fill out the REPAIR/SERVICE ORDER form in this manual and ship it along with the malfunctioning equipment to Dranetz Customer Service Department. If this form is missing, contact Dranetz to request a replacement.

3. You have been supplied a Control Form in this manual with a Control Number. This form is used if you want the Volume 2 of this manual (for Service and Maintenance). If this form is missing, contact Dranetz to request a replacement.

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REPAIR/SERVICE ORDER FORM

IMPORTANT: Enclose this form with returned equipment (see other side for instructions)

DRANETZ TECHNOLOGIES, INC.
Customer Service Department
4 Gladys Court, P.O. Box 4018
Edison, New Jersey 08818-4018

Tel: (201) 287-3680
FAX: (201) 248-9240

Ship to:_____

_____

_____

_____

Reference/P.O.#_____

Invoice to:_____

_____

_____

_____

EQUIPMENT BEING RETURNED

Model No._____ S/N_____ Model No._____ S/N_____
Model No._____ S/N_____ Model No._____ S/N_____
Model No._____ S/N_____ Model No._____ S/N_____

Accessory equipment also being returned (fill this out to assure return to you):
☐ Power & Other Cables_____ ☐ Instr. Book_____
☐ Other_____

RETURN AUTHORIZATION

If you have discussed the problem with Dranetz Sales or Service personnel, who did you speak with?_____
Dranetz Return Authorization No._____ By_____ Date_____
Who should Dranetz Customer Service contact for technical questions?

_____
Name (please print) Department Telephone Number

DESCRIPTION OF THE PROBLEM

Reason for return: ☐ Defect ☐ Calibration ☐ Battery Replacement
Please provide a detailed description of the problem, including any test data results (service cannot be performed without this information). Attach additional sheets if necessary.

_____

_____

_____

_____

Check where applicable. Is the malfunction related to:
☐ Warm-up ☐ Temperature ☐ Intermittence ☐ Grounding
☐ Mechanical Handling ☐ Visual Defects ☐ Check if Test Data is Attached

INITIATOR OF THIS REPAIR/SERVICE ORDER

_____
Name/Title (please print) Signature Telephone Number

INSTRUCTIONS FOR THE REPAIR/SERVICE ORDER

IMPORTANT: Follow all instructions and use this form to help us help you.

1. Before returning any equipment, call our Customer Service Dept. at (201) 287-3680. Give the service representative the model and serial numbers of your equipment, and any information regarding your problem.

    a. Our specialists may be able to solve your problem without need for equipment return.

    b. If equipment return is necessary, you will be supplied appropriate instructions and authorization information to expedite service.

2. If equipment return is necessary:

    a. Fill out the other side of this form **COMPLETELY**.

    b. Enclose this form inside the shipping carton. If possible, attach this form by masking tape to the equipment.

    c. Ship prepaid (including insurance); we will return prepaid unless you advise us otherwise.

    d. **IMPORTANT** - Pack properly! Dranetz Technologies, Inc. will not be liable for shipping damage.

NOTE:

Within the Continental United States, all material will be returned by Dranetz Technologies, Inc. to you by UPS, UPS Blue, UPS Red, or another carrier chosen by Dranetz unless we are instructed otherwise.

Warranty Information:

Statement of Warranty - All products of Dranetz Technologies, Inc. are warranted to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective material returned freight prepaid during the warranty period. There is no charge for this repair provided there is no evidence that the equipment has been mishandled or abused.

SECTION II
INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation, setup, and operating instructions for the 656 Disturbance Waveform Analyzer.

2.2 UNPACKING

For maximum protection against possible shipping damage, the 656 has been sealed in a two-piece, pre-molded urethane foam pack, encapsulated within a durable shipping carton.

Unpack the unit from the carton as follows:

1. Remove any remaining literature inside the top of the carton.
2. Carefully remove the unit from its shipping carton.
3. Remove the power cord and any additional parts inside the carton.
4. Place all of the shipping materials back into the carton, close its flaps, and store it away. **DO NOT throw away the carton and packing materials. Save the carton and packing materials in case you have to return the unit to Dranetz Customer Service Department for maintenance, repair, or calibration.**

2.2.1 Shipping Damage Inspection

Visually inspect the unit for possible shipping damage. If any damage exists, first notify and file an insurance claim with your carrier or underwriter or both. Then notify Dranetz Customer Service Department (refer to the REPAIR/SERVICE ORDER form enclosed in this manual) of your intentions to return the unit. **DO NOT** return the unit without prior instructions from Dranetz Customer Service Department.

2.2.2 Repacking the 656 for Return Shipment

If you have to return the 656 to Dranetz Customer Service Department, repack it in its original packing materials, making certain to replace the 656 inside its plastic bag to keep out dust and particles. **DO NOT RETURN THE 656 IN AN UNPACKED BOX. DRANETZ TECHNOLOGIES, INC. WILL NOT BE RESPONSIBLE FOR DAMAGE INCURRED DURING TRANSIT DUE TO INADEQUATE PACKING ON YOUR PART.**

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2.3 INSTALLATION WARNING

WARNING

Be sure that the 656 is off before proceeding with any installation. Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) and any other requirements which are applicable to your installation. Installing, operating, and maintaining this instrument should be performed ONLY by qualified personnel. At the time of this writing, Underwriters Laboratories has determined that the qualifications for performing such procedures should be self-determined by the individual performing the task.

2.4 SETTING UP THE 656

Initial setup of the 656 involves standing it up, opening its keyboard, making any required communication connections, connecting the Main input channels, connecting the Sensor input channels (if applicable), and applying power.

2.4.1 Moving the Four-Position Handle/Stand

1. Stand the 656 on its rubber feet with its handle facing forward.
2. With both hands, press in on the two outside knobs on the handle/stand to release it from its locked position.
3. Raise the front of the 656 to one of its three standing positions.

2.4.2 Uncovering the Keyboard

1. Insert the key into the keyboard lock and turn it ¼ turn counterclockwise. Remove the key and store it in a safe place.
2. Gently fold down the keyboard until it comes to rest on the surface.

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CAUTION

If you are going to operate the 656 in a "dirty" environment, leave the keyboard closed when you are not using the printer, screen, or keyboard. This protects the inside of the instrument from dust or other airborne contaminants.

2.4.3 Connecting the RS-232C Cables for Remote Operation or External Printing

The next two subsections provide information on connecting RS-232C cables to the Main and Auxiliary Ports. Connection to the Main Port lets the 656 communicate with another 656 or a personal computer during remote operation. Connection to the Auxiliary Port lets the 656 print to an external printer or other output device.

2.4.3.1 Connecting the 656 to a Personal Computer or Another 656

Connection to another 656 or personal computer is made through the Main Port. The Main Port is a 25-pin female connector. You can directly connect this port to another 656 within 50 feet using Dranetz Main Port Null-Modem Cable 113446-G1. For greater distances, you can connect the 656 to a modem using this same cable. If you are using Dranetz software for operation from a personal computer, cable 113449-G1 is required (refer to your Dranetz Software Operator's Guide).

2.4.3.2 Connecting the 656 to an External Printer or Other Output Device

Connection to an external printer or other output device is made through the Auxiliary Port. The Auxiliary Port is a 9-pin female connector. You directly connect the Auxiliary Port to an external printer or output device's 25-pin female connector using Dranetz Auxiliary Port Cable 113447-G1. If you are using Dranetz Data Management software and want to use a personal computer as an output device, cable 113448-G1 is required (refer to your Dranetz Data Management Software Operator's Guide).

2.4.4 Connecting the Power Cord

Plug the female end of the power cord into the 656 rear panel receptacle; plug the male end into an appropriate 3-pronged AC power outlet. **NOTE**: If operating the 656 outside of the U.S., refer to Appendix D for the types of electrical plugs and nominal voltages in other countries, as well as the recommended Main Channel Setups to use.

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2.4.5 Connecting the Main Input Channels

The 656 and 656A have four Main input channels: A, B, C, and D (see Figure 2-1). For the 656, each channel consists of a pair of "+", "−", and ground screw terminals. For the 656A, each channel consists of a pair of "+" and "−" voltage input jacks, but only channel A contains a grounding lug; channels B, C, and D contain a "CURRENT" input connector. Connect these channels as follows:

1. Turn off the 656 but leave its power cord plugged in to maintain a safety ground connection.

2. Turn off the power to the line(s) that are going to be monitored.

3. Read the circuit connection guidelines and circuit applications in Subsections 2.4.5.1 through 2.4.5.3 before continuing.

4a. *656 ONLY*
For the 656, remove the safety cover of the barrier strip you are going to wire (only remove the one you will be working on). Connect a line to the three terminal leads for the channel as illustrated in Figure 2-1 (connect the channel A ground to a verified earth ground). Replace the safety cover, and repeat this step for the remaining channels you want wired (refer to TM-113807 in the back of this manual for the optional cable sets available and their connections).

4b. *656A ONLY*
For the 656A, connect the applicable voltage lines in your Measurement Cable Kit (114012-G1) to the "+" and "−" input jacks. **Note**: Refer to the illustrations under Subsection 2.4.5.3 (Figures 2-2 through 2-10) for the connection guidelines.

5. *656A ONLY*
Connect the grounding lug of channel A to suitable earth safety ground using the green ground cable provided.

6. *656A ONLY*
If you are using a current probe with the 656A, plug the connector end of the TR-2019A current probe into the "CURRENT" input jacks of the channel(s) you are using. (**NOTE**: If you are using the TR-2015A current probe with the CT Termination Box, see Subsection 2.4.5.1 for instructions.)

NOTE

For the 656A, you cannot monitor voltage and current at the same time on one channel. The Setup menu allows you to switch between voltage and current monitoring. Once voltage monitoring is selected, current monitoring is disabled; once current monitoring is selected, voltage monitoring is disabled.

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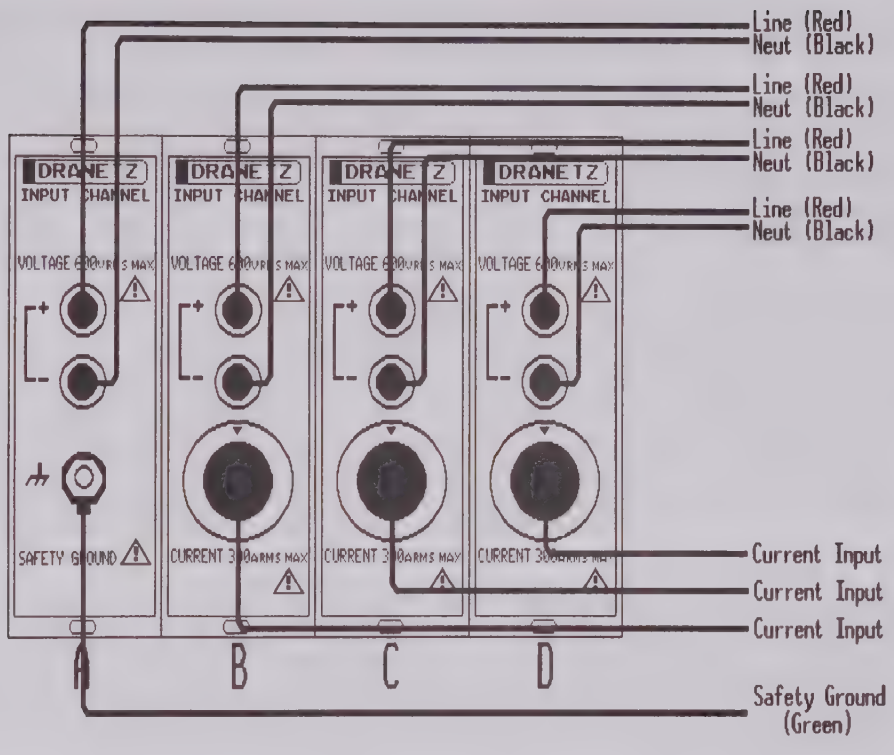

FIGURE 2-1A. MAIN INPUT CHANNEL CONNECTIONS (656A)

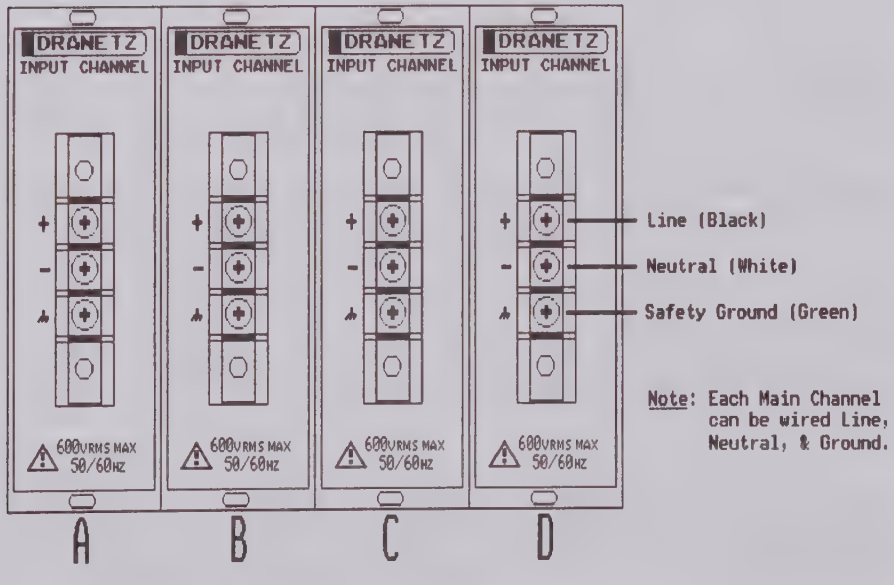

FIGURE 2-1B. MAIN INPUT CHANNEL CONNECTIONS (656)

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2.4.5.1 Using Current Probes and the CT Termination Box (656A ONLY)

With the 656A, the "CURRENT" input jacks are specifically designed for use with the Dranetz TR-2019A current probes (111666) if you are monitoring currents of 300 A rms or less (see the next paragraph if you intend to monitor greater currents).

CT Termination Box

WARNING

When using the CT Termination Box, be sure to replace its terminal cover on the barrier block as soon as the current probe wires are connected. Also, remove the current probe from the line being monitored before attaching or removing the wires of the current probe secondary to or from the barrier block on the Box.

If you want to monitor currents greater than 300 A rms, the TR-2019A current probe cannot be used. You must instead order the Dranetz TR-2015A current probe and CT Termination Box (110639-G2). The CT Termination Box reduces the input from the current probe to a range acceptable to the 656. The TR-2015A current probe is rated at 3000 A rms and contains a 5A secondary for use with the CT Termination Box. To make the connection, plug the connector end of the CT Termination Box into the applicable current connector and hard wire the box's screw terminals to the current probe cable.

2.4.5.2 Circuit Connection Guidelines for the Main Input Channels

Proper monitoring and analysis of AC and DC disturbances requires careful attention to the method of connection between the 656 Main input channels and the monitored circuits. To obtain the most accurate and relevant monitoring data, we suggest the following guidelines:

- Be aware that frequency information is primarily measured on channel A. If the line on channel A drops out, frequency is measured on the next available channel: B then C then D. Never connect channel A from Neutral-to-Ground and never try to synchronize off a current waveform (current is unreliable for synchronization).

- As a convention, always connect channel D from Neutral-to-Ground unless you are monitoring DC inputs or current on channel D.

- The safety ground on channel A (lug for 656A and screw terminal for 656) acts as a common grounding point and is internally tied to the 656 frame ground--which is connected to the line cord earth ground. Make sure that the grounding lug is connected to a verified safety ground using the green grounding cable provided.

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- Whenever possible, power the 656 from a separate line other than the one you are monitoring. This prevents the 656 from filtering out the disturbances you are trying to monitor.

- For the 656A: To minimize spurious impulse transients and interchannel coupling, always use the Dranetz Main Input Channel cables contained in your Measurement Cable Kit (114012-G1). For the 656, cable sets 113806 and 113807 are available (refer to TM-113807 in the back of this manual).

- If you are monitoring a power line connected to critical, sensitive load equipment, the test cable length should be connected as close as possible to the load. For 3ϕ loads, connect the 656 in the same way as the load equipment, for example, Line-to-Line or Line-to-Neutral.

2.4.5.3 Circuit Applications for the Main Input Channels

- The 656 can monitor Line-to-Neutral and Neutral-to-Ground voltage in a 120V ac single phase (1ϕ) system (illustrated in Figure 2-2). This application requires two Main channels (A and D in the illustration). With the 656A in such an application, one of the two remaining channels could be used to monitor current (illustrated in Figure 2-3 using channel B).

- The 656 can monitor Line A-to-Neutral, Line B-to-Neutral, and Neutral-to-Ground voltages in a 120V AC split phase system, while also monitoring Line A-to-Line B voltage in a 240V AC split phase system (illustrated in Figure 2-4). This application would use all four Main channels. With the 656A, you could also monitor current on channels B and C while using channel A as the synchronization channel and channel D for Neutral-to-Ground voltages (illustrated in Figure 2-5).

- The 656 can monitor Line A-to-Line B, Line B-to-Line C, and Line A-to-Line C voltages in a 3ϕ "delta" system (illustrated in Figure 2-6). This application would use three of the four Main channels (channels A, B, and C in the illustration). With the 656A, you could also monitor 3ϕ current on channels B, C, and D while using channel A as the synchronization channel (illustrated in Figure 2-7).

- The 656 can monitor Line A-to-Neutral, Line B-to-Neutral, Line C-to-Neutral, and Neutral-to-Ground voltages in a 3ϕ "wye" system (see Figure 2-8). This application would use all four Main channels. With the 656A, you could also monitor 3ϕ current on channels B, C, and D while using channel A as the synchronization channel (illustrated in Figure 2-9).

- The 656 can monitor up to three DC inputs using Main input channels B, C, and D. For this configuration, Main channel A should be set up to monitor Line A-to-Neutral voltage (illustrated in Figure 2-10).

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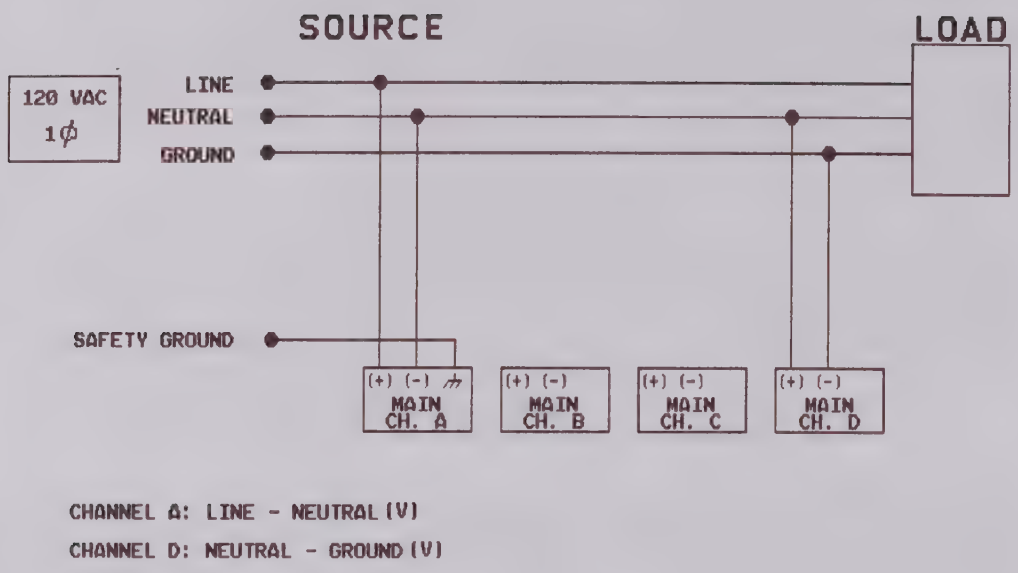

FIGURE 2-2. 120V AC SINGLE PHASE (1φ) CONNECTIONS

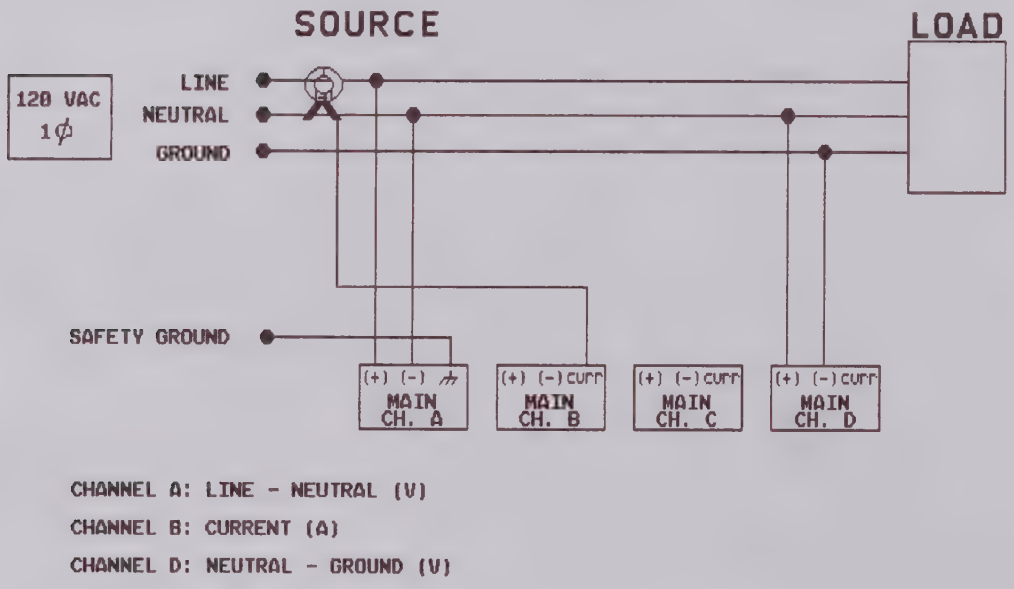

FIGURE 2-3. 120V AC SINGLE PHASE (1φ) CONNECTIONS WITH CURRENT INPUT (656A ONLY)

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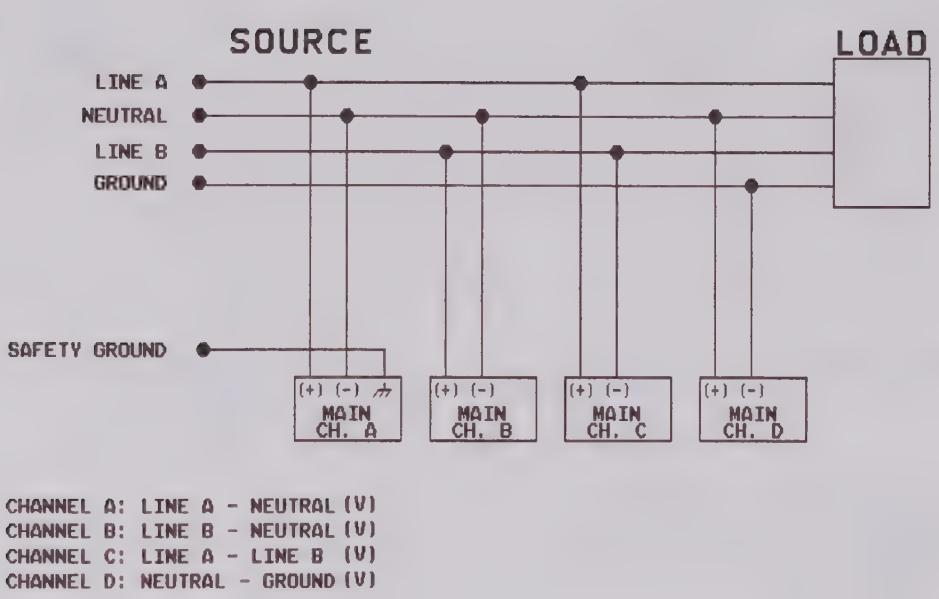

FIGURE 2-4. 120V/240V AC SPLIT PHASE CONNECTIONS

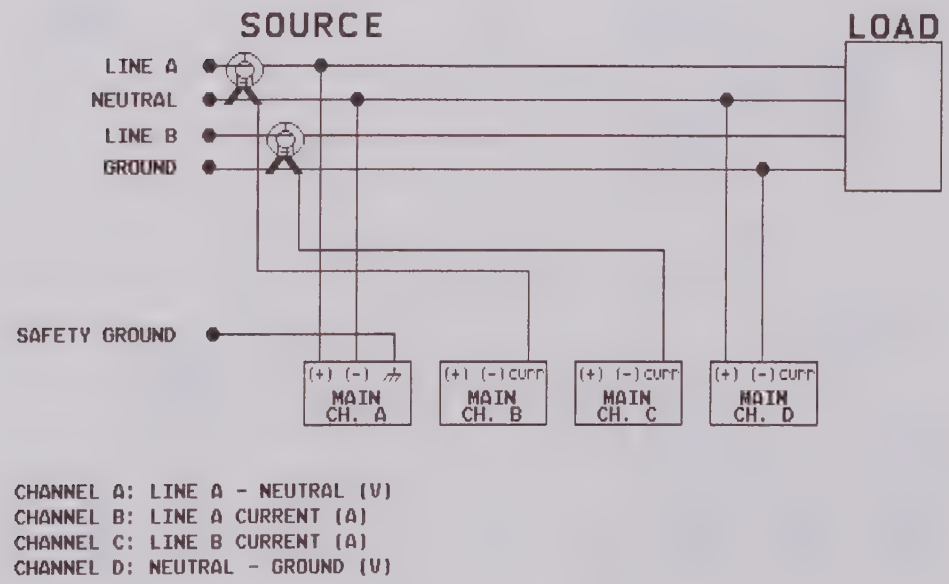

FIGURE 2-5. 120V/240V AC SPLIT PHASE CONNECTIONS WITH CURRENT INPUTS (656A ONLY)

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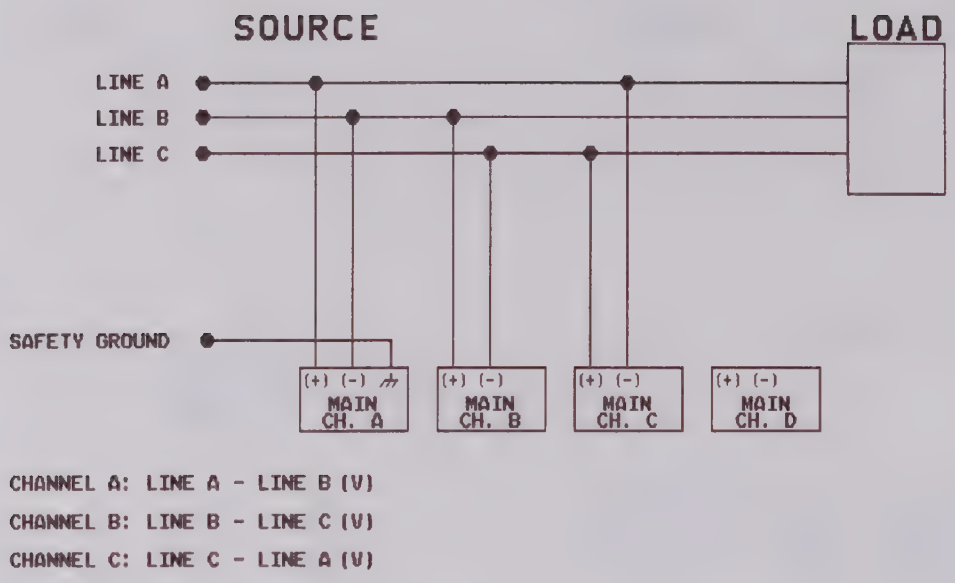

FIGURE 2-6. THREE PHASE (3ϕ) "DELTA" CONNECTIONS

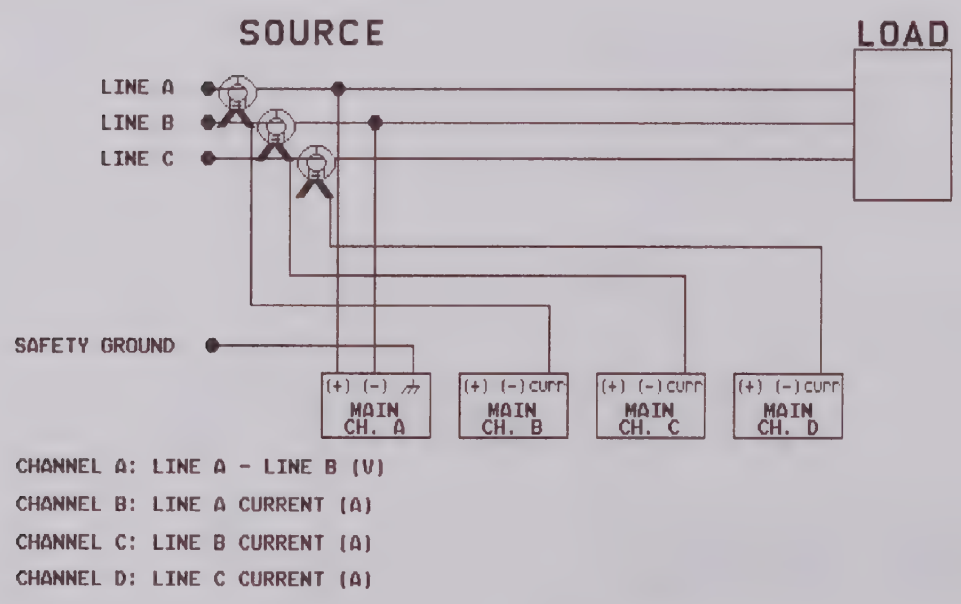

FIGURE 2-7. THREE PHASE (3ϕ) "DELTA" CONNECTIONS WITH CURRENT INPUTS (656A ONLY)

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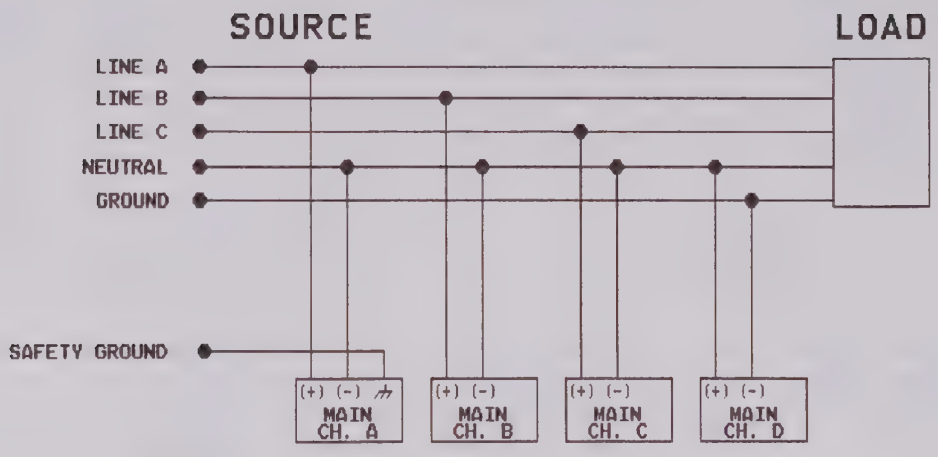

FIGURE 2-8. THREE PHASE (3ϕ) "WYE" CONNECTIONS

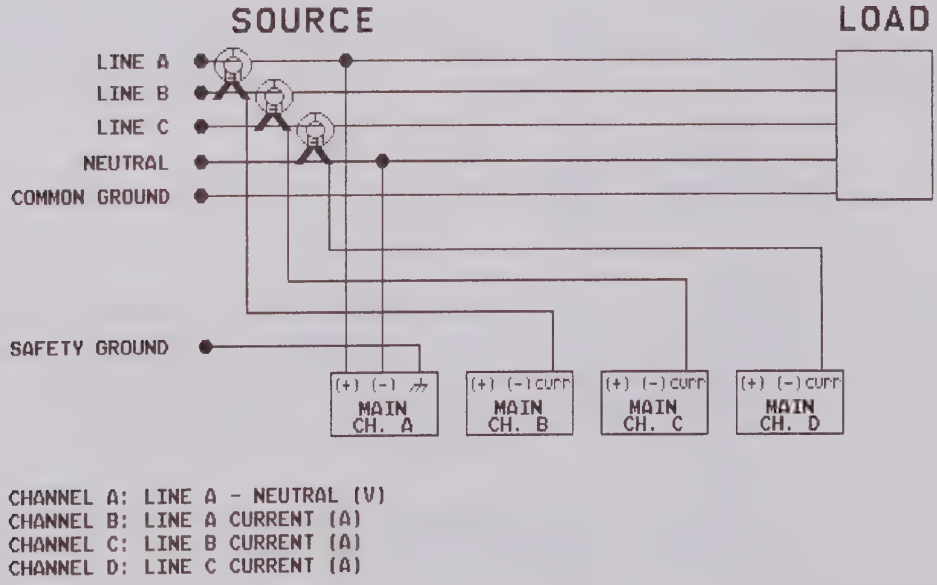

FIGURE 2-9. THREE PHASE (3ϕ) "WYE" CONNECTIONS WITH CURRENT INPUTS (656A ONLY)

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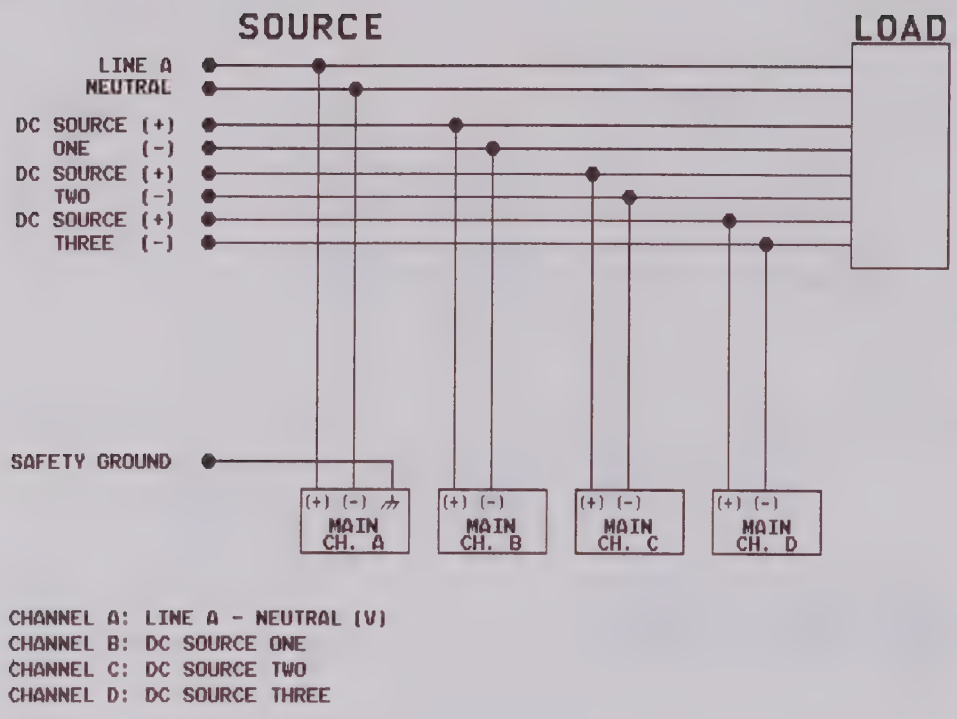

FIGURE 2-10. TYPICAL 3-SOURCE DC INPUT CONNECTIONS

Below is a suggested example of a Main Channel Setups Screen that Corresponds to the above configuration:

```
1 Setup #16 A      B      C      D
2 Range     VH     VL     VL     VL


6 Imp.      1000 100.0 050.0 200.0
7 Wave       002  02.0  05.0  02.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

NOTE

Voltage thresholds are set for AC rms changes. For DC changes, you must remove the rms factor of 1.414 (square root of 2). Do this by taking the DC voltage setting you want and dividing it by 1.414. For example: If you want 7V DC as the trip point, set the sensitivity threshold ("Wave") to 7÷1.414 ≈ 5.0 (as in channel C above).

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2.4.6 Connecting the Sensor (Transducer) Channel Options

To use any of the Sensor channel options, 656-PA-1001 (Transducer Channel Board) must be installed in the Mainframe. If you do not have this board but would like to use the Sensor Channel options, contact Dranetz Order Entry Department (see Subsection 1.10).

As of this writing, there are three Sensor channel options available for the 656:

1. Temperature & Humidity Monitor (656-XD-1001)
2. Conducted RF Monitor (656-XD-1002)
3. Radiated RF Monitor (656-XD-1003)

Information on the connections, setup, operation, and specifications for these options is contained in the tabbed sections (656-XD-1001, -1002, -1003) in this manual. For information on purchasing any or all of these options, contact Dranetz Order Entry Department (see Subsection 1.10).

Figure 2-11 below illustrates the Sensor (Transducer) Channel inputs for the available options:

Note: All eight Sensor channels are factory preset for 0-10V input. To change any input to 0-40mA, contact Dranetz Customer Service Department for instructions (see Subsection 1.11).

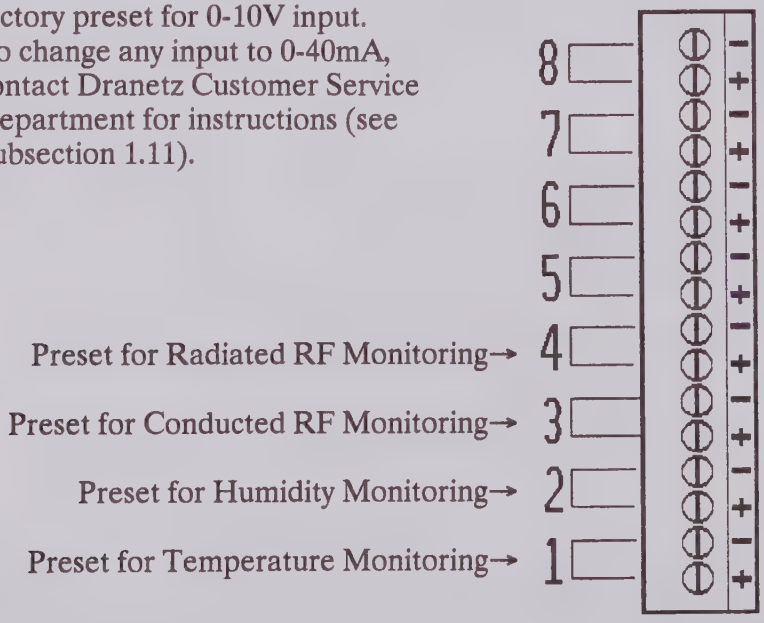

FIGURE 2-11. SENSOR (TRANSDUCER) CHANNEL INPUTS

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2.5 BEGINNING OPERATION

If you are installing the 656 for the first time, or if you have not operated it for two weeks or longer, plug it in, turn it on, and let is sit for 24 hours to allow the internal UPS batteries to fully charge.

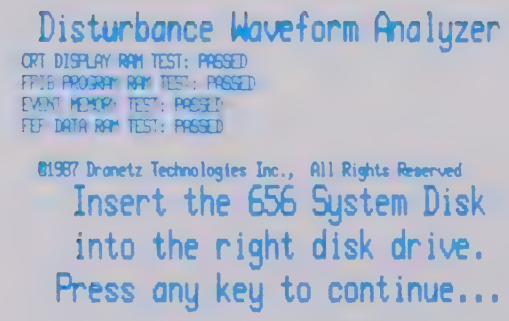
At this point it is assumed the 656 has been properly connected and is ready for operation. You should now perform an operational test to verify that all systems are functioning properly. Go to Section III in this manual and perform the operational test. If you have any of the Optional Sensor Monitors installed, also look over the applicable sections pertaining to these monitors (656-XD-1001, -1002, -1003).

It is now assumed that you have completed all required operational tests. General operation of the 656, including any setups, is done through a system of self-prompting menus and screens discussed in the subsections below.

2.5.1 Initial Start-Up

Turn the SETUP knob on the front panel to the setup number you want the 656 to begin monitoring when it is first turned on. This is the only purpose of this knob. Once the 656 is on, setups are only changed through the Main Channel Setups screens.

Turn on the 656. The instrument will automatically perform a diagnostics self-test, checking out the integrity of its various subsystems. If all tests are passed, the Start-Up Screen appears:


Disturbance Waveform Analyzer
CRT DISPLAY RAM TEST: PASSED
FPIB PROGRAM RAM TEST: PASSED
EVENT MEMORY TEST: PASSED
REF DATA RAM TEST: PASSED
©1987 Dranetz Technologies Inc., All Rights Reserved
Insert the 656 System Disk
into the right disk drive.
Press any key to continue...

In an actual display, the version number of the system ROMs appear in the upper left corner and any malfunctions detected are listed. See Section III for further instructions if this occurs. Also, when the 656 is first turned on, a power on event and reference events are recorded (when the 656 is turned off, a power off event is recorded).

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2.5.1.1 Start-Up Screen

The Start-Up Screen prompts you to insert the 656 System disk into the right disk drive and to press any key to continue.

2.6 OPERATING THE 656

Insert the 656 System Disk into the right disk drive and press any key. The program on the disk takes about 25 seconds to load. After it's loaded, the 656 Status Screen appears:

```
Status as of 04/14/88 @ 16:07:37
 * * * Monitoring is On * * *
Main Ch. On: A  Freq:<45.0
Sensor Chan. On: None
Memory: 14 Events (1% Full)
Last Event: 04/14/88 @ 16:07:25
Setup:1   Knob:1   Printer:656

Press any key for the MAIN MENU
```

The above Status Screen indicates the following:

- monitoring is on,
- channel A is on and channels B, C, and D are off,
- the current frequency of the Synchronization channel is less than 45.0 Hz,
- none of the eight Sensor (Transducer) channels are on,
- 14 events are in memory and memory is 1% full,
- the last event recorded was on 4/14/88 at 16:07:37,
- the active setup is "1" and the SETUP knob is set to position "1," and
- the active printer is the internal 656 printer

2.7 656 MENU STRUCTURE

Figure 2-12 illustrates the 656 menu structure. All commands and operations are performed through these menus. Subsections 2.8 through 2.8.6.2 describe these commands and operations.

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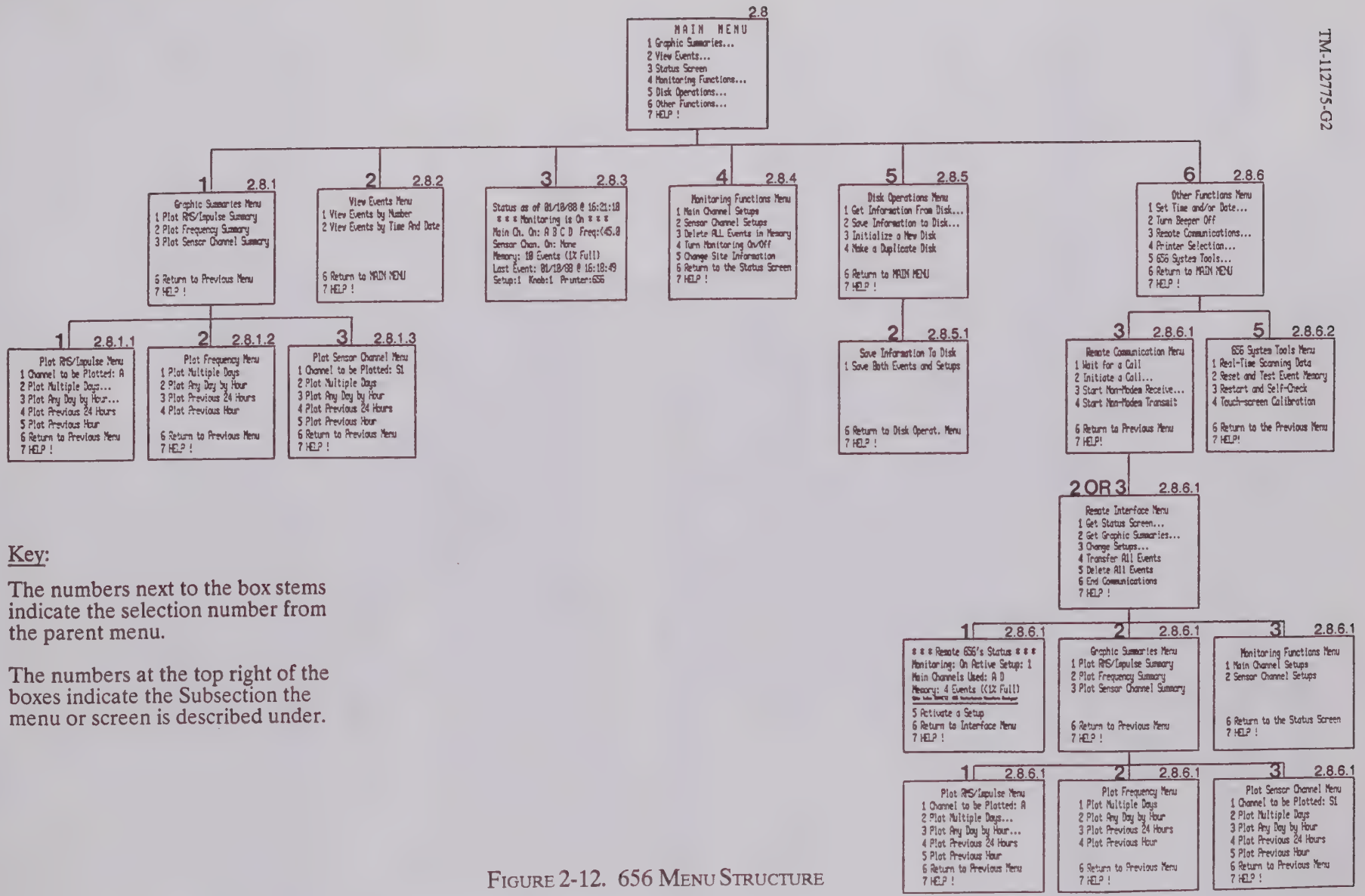

Key:

The numbers next to the box stems indicate the selection number from the parent menu.

The numbers at the top right of the boxes indicate the Subsection the menu or screen is described under.

FIGURE 2-12. 656 MENU STRUCTURE

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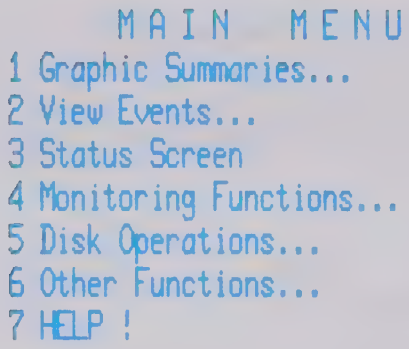
2.8 MAIN MENU

The Main Menu is the top menu in the 656 menu structure:



From the Main Menu you can work your way down to any menu or Setup Screen in the structure.

Possible Selections and What They Mean

Selection: **1 Graphic Summaries**

Application: Selection 1 puts you in the Graphic Summaries Menu where you can plot RMS, impulse, and frequency summaries. Summaries can be plotted in multiple days, specific hours, previous 24 hours, or previous hour. Summaries can be graphical illustrations, text descriptions, or both.

Described in: 2.8.1

Selection: **2 View Events**

Application: Selection 2 puts you in the View Events Menu where you can view events according to their sequential order in memory or according to the time and date they occurred.

Described in: 2.8.2

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Selection: **3 Status Screen**

Application: Selection 3 brings up the Status Screen. The Status Screen indicates the monitoring status, Main channel statuses, Synchronization channel frequency, Sensor (Transducer) channel statuses, number of events in memory, percentage of memory used, the active setup, SETUP knob position, and the time and date of the last event recorded.

Described in: 2.8.3

Selection: **4 Monitoring Functions**

Application: Selection 4 puts you in the Monitoring Functions Menu where you can view or change the 16 Main channel setups, view or change the 8 Sensor (Transducer) channel setups, delete all events in memory, turn monitoring on and off, and change site descriptions.

Described in: 2.8.4

Selection: **5 Disk Operations**

Application: Selection 5 puts you in the Disk Operations Menu where you can load stored disk information to the 656, save recorded 656 information to a disk, initialize a new disk, and create a duplicate disk.

Described in: 2.8.5

Selection: **6 Other Functions**

Application: Selection 6 puts you in the Other Functions Menu where you can set the internal clock's time and date, turn the beeper on and off, access remote communications, change the active printer, access the 656 system tools (to test memory, recalibrate the touch-screen, and restore factory preset values for the setups).

Described in: 2.8.6

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 6.

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2.8.1 Graphic Summaries Menu

Selection 1 in the Main Menu puts you in the Graphic Summaries Menu:

```
Graphic Summaries Menu
1 Plot RMS/Impulse Summary
2 Plot Frequency Summary
3 Plot Sensor Channel Summary


6 Return to Main Menu
7 HELP !
```

Possible Selections and What They Mean

Selection: **1 Plot RMS/Impulse Summary**

Application: Refer to Subsection 2.8.1.1

Selection: **2 Plot Frequency Summary**

Application: Refer to Subsection 2.8.1.2

Selection: **3 Plot Sensor Channel Summary**

Application: Refer to Subsection 2.8.1.3

Selection: **6 Return to Main Menu**

Application: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 3.

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2.8.1.1 Plot RMS/Impulse Summary Menu

Selection: Selection 1 in the Graphic Summaries Menu puts you in the Plot RMS/ Impulse Menu:

```
Plot RMS/Impulse Menu
1 Channel to be Plotted: A
2 Plot Multiple Days...
3 Plot Any Day by Hour...
4 Plot Previous 24 Hours
5 Plot Previous Hour
6 Return to Previous Menu
7 HELP !
```

Possible Selections and What They Mean

Selection: **1 Channel to be Plotted**

Application: Selection 1 alternates the channel to be plotted from A through D. Each of the 16 setups contains programming for channels A through D.

Selection: **2 Plot Multiple Days**

Application: Selection 2 immediately prompts you for a start date for the multiple days plot:

```
Start Date mm/dd/yy =>
```

You can either enter a start date or press <*Return*> to take the date of the first event in memory.

You are then prompted for an end date for the plot:

```
End Date mm/dd/yy =>
```

You can either enter an end date or press <*Return*> to take the date of the last event in memory.

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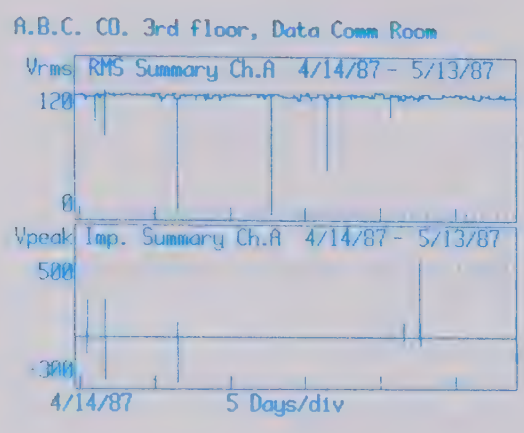
You are then prompted to press <*Return*> to execute the plot. A display such as the following appears (the following displays assume voltage was recorded; if current was recorded with a 656A, "Vrms" and "Vpeak" would be replaced with "Arms" and "Apeak"):



You can then press <*P*> to print the display or press <*T*> for a text description:

```
                Ch. A RMS/Impulse Plot Summary

A.B.C. CO. 3rd floor, Data Comm Room

Start on Event # 1      End on Event # 329
      Start Time:  4/14/87  17:10
      End Time:    5/13/87  23:59

                Worst RMS Events
     Max Value = 123.1 Vrms  Event # 50
     Min Value = 0.0 Vrms    Event # 142

              # Impulse Events = 8
  Worst Pos Value = 528 Vpeak   Event # 278
  Worst Neg Value = -324 Vpeak  Event # 88
```

The text indicates the site description, the starting and ending event numbers and their time and date, the maximum and minimum RMS event values and their time and date, the number of impulse events recorded, and the event number and value of the worst positive and negative impulse events.

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Selection: 3 Plot Any Day by Hour

Application: Selection 3 immediately prompts you for the plot date:

Plot Date mm/dd/yy =>

If you press <*Return*>, the current date is used as the plot date.

You are then prompted for a start hour:

Start Hour (0 to 23) =>

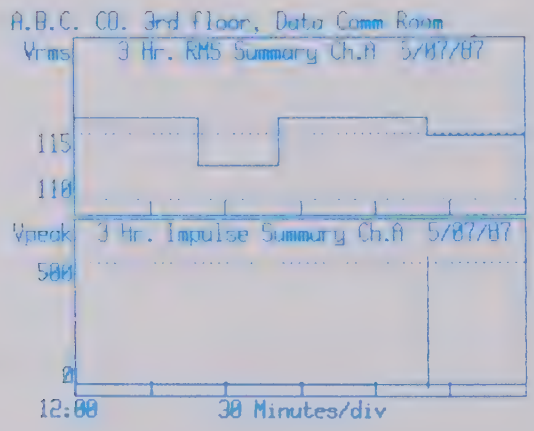
If you press <Return>, the hour of the first event since midnight is taken as the default.

You are then prompted for an end hour:

End Hour (1 to 24)

If you press <*Return*>, the hour of the last event before midnight of the next day is taken as the default.

You are then prompted to press <*Return*> to execute the plot and a display such as the following appears:



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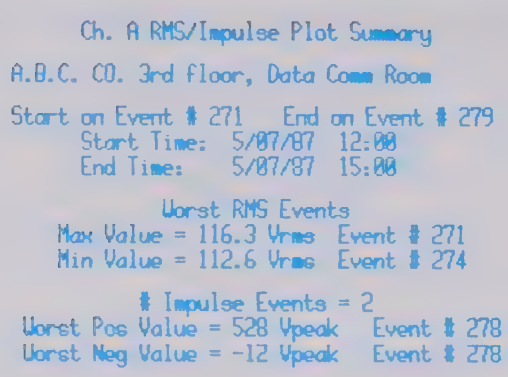
You can then press <*P*> to print this display or press <*T*> for a text description:


Ch. A RMS/Impulse Plot Summary
A.B.C. CO. 3rd Floor, Data Comm Room
Start on Event # 271 End on Event # 279
Start Time: 5/07/87 12:00
End Time: 5/07/87 15:00
Worst RMS Events
Max Value = 116.3 Vrms Event # 271
Min Value = 112.6 Vrms Event # 274
Impulse Events = 2
Worst Pos Value = 528 Vpeak Event # 278
Worst Neg Value = -12 Vpeak Event # 278

The text indicates the site description, the starting and ending event numbers and their time and date, the maximum and minimum RMS event values and their time and date, the number of impulse events recorded, and the event number and value of the worst positive and negative impulse events.

Selection: **4 Plot Previous 24 Hours**

Application: Selection 4 immediately plots the previous 24 hours. You can then press <*P*> to print this display or press <*T*> for a text description.

This plot is similar to the one in selection 3 and is therefore not shown here.

Selection: **5 Plot Previous Hour**

Application: Selection 5 immediately plots the previous hour. You can then press <*P*> to print this display or press <*T*> for a text description.

This plot is similar to the one in selection 3 and is therefore not shown here.

Selection: **6 Return to Previous Menu**

Application: Selection 6 returns you to the Graphic Summaries Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 5.

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2.8.1.2 Plot Frequency Menu

Selection 2 in the Graphic Summaries Menu puts you in the Plot Frequency Menu:

```
        Plot Frequency Menu
1 Plot Multiple Days
2 Plot Any Day by Hour
3 Plot Previous 24 Hours
4 Plot Previous Hour

6 Return to Previous Menu
7 HELP !
```

Possible Selections and What They Mean

Selection: **1 Plot Multiple Days**

Application: Selection 1 immediately prompts you for a start date for the multiple days plot:

```
Start Date  mm/dd/yy =>
```

You can either enter a start date or press <*Return*> to take the date of the first event in memory.

You are then prompted for an end date for the plot:

```
End Date  mm/dd/yy =>
```

You can either enter an end date or press <*Return*> to take the date of the last event in memory.

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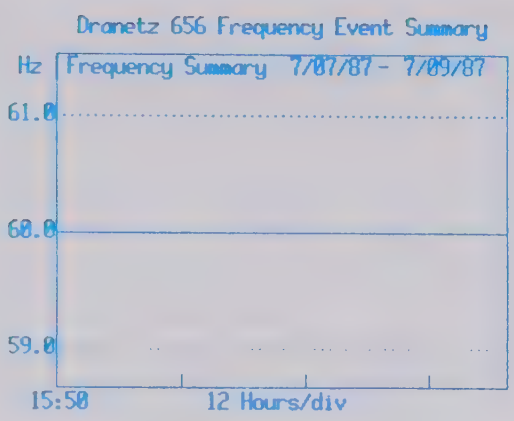
You are then prompted to press <*Return*> to execute the plot and a display such as the following appears:



Note:
The frequency remained constant at 60.0 Hz throughout this period.

You can then press <*P*> to print this display. **Note**: Text descriptions are not applicable for frequency plots.

Selection: **2 Plot Any Day by Hour**

Application: Selection 2 immediately prompts you for the plot date:

Plot Date mm/dd/yy =>

If you press <*Return*>, the current day is used as the plot date.

You are then prompted for a start hour:

Start Hour (0 to 23) =>

If you press <*Return*>, the hour of the first event since midnight is taken as the default.

You are then prompted for an end hour:

End Hour (1 to 24)

If you press <*Return*>, the hour of the last event before midnight of the next day is taken as the default.

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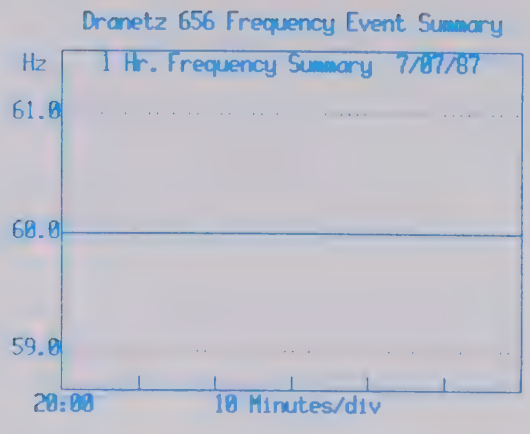
You are then prompted to press <*Return*> to execute the plot and a display such as the following appears:



You can then press <*P*> to print this display. **Note**: Text descriptions are not applicable for frequency plots.

Selection: **3 Plot Previous 24 Hours**

Application: Selection 3 plots the previous 24 hours. You can then press <*P*> to print this display. **Note**: Text descriptions are not applicable for frequency plots.

Selection: **4 Plot Previous Hour**

Application: Selection 4 immediately plots the previous hour. You can then press <*P*> to print this display. **Note**: Text descriptions are not applicable for frequency plots.

The plot is similar to the one in selection 2 and is therefore not shown here.

Selection: **6 Return to Previous Menu**

Application: Selection 6 returns you to the Graphic Summaries Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

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2.8.1.3 Plot Sensor Channel Menu

Selection 3 in the Graphic Summaries Menu puts you in the Plot Sensor Channel Menu:

```
    Plot Sensor Channel Menu
1 Channel to be Plotted: S1
2 Plot Multiple Days
3 Plot Any Day by Hour
4 Plot Previous 24 Hours
5 Plot Previous Hour
6 Return to Previous Menu
7 HELP !
```

Selection: **1 Channel to be Plotted**

Application: Selection 1 alternates the channel to be plotted from S1 through S8. Each channel can be programmed separately.

Selection: **2 Plot Multiple Days**

Application: Selection 2 immediately prompts you for a start date for the multiple days plot:

```
Start Date  mm/dd/yy =>
```

You can either enter a start date or press <*Return*> to take the date of the first event in memory.

You are then prompted for an end date for the plot:

```
End Date  mm/dd/yy =>
```

You can either enter an end date or press <*Return*> to take the date of the last event in memory.

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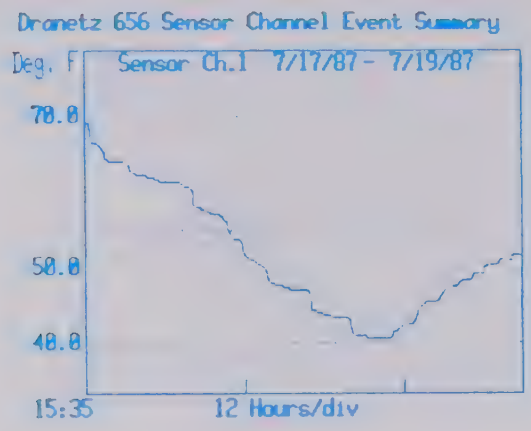
You are then prompted to press <*Return*> to execute the plot and a display such as the following appears:



You can then press <*P*> to print this display.

NOTE

Text descriptions of Sensor Channel plots are not applicable. Text descriptions of individual events (by sequential occurrence or by specific time and date) can be obtained in the View Events menu. Examples of text descriptions appear in the Sensor channel sections in the back of this manual (656-XD-1001, 656-XD-1002, and 656-XD-1003).

Selection: **3 Plot Any Day by Hour**

Application: Selection 3 immediately prompts you for the plot date:

Plot Date mm/dd/yy =>

If you press <*Return*>, the current day is used as the plot date.

You are then prompted for a start hour:

Start Hour (0 to 23) =>

If you press <*Return*>, the hour of the first event since midnight is taken as the default.

You are then prompted for an end hour:

End Hour (1 to 24)

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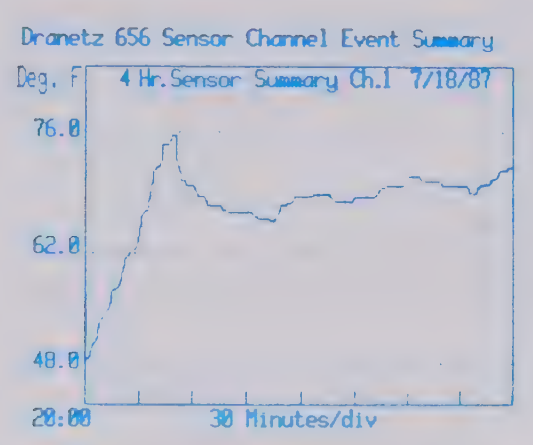
If you press <*Return*>, the hour of the last event before midnight of the next day is taken as the default.

You are then prompted to press <*Return*> to execute the plot and a display such as the following appears:



You can then press <*P*> to print this display.

NOTE

Text descriptions of Sensor Channel plots are not applicable. Text descriptions of individual events (by sequential occurrence or by specific time and date) can be obtained in the View Events menu. Examples of text descriptions appear in the Sensor channel sections in the back of this manual (656-XD-1001, 656-XD-1002, and 656-XD-1003).

Selection: **4 Plot Previous 24 Hours**

Application: Selection 4 immediately plots the previous 24 hours. You can then press <*P*> to print this display. **Note**: Text descriptions are not applicable for Sensor channel plots.

The plot is similar to the one in selection 3 and is therefore not shown here.

Selection: **5 Plot Previous Hour**

Application: Selection 5 immediately plots the previous hour. You can then press <*P*> to print this display. **Note**: Text descriptions are not applicable for frequency plots.

The plot is similar to the one in selection 3 and is therefore not shown here.

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Selection: **6 Return to Previous Menu**

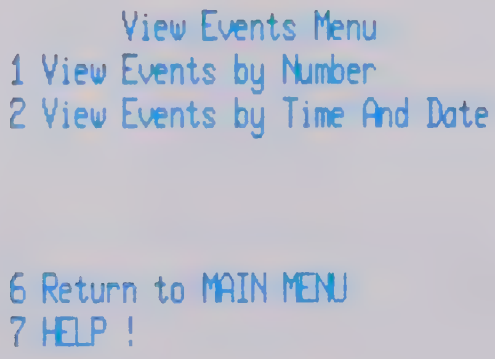
Application: Selection 6 returns you to the Graphic Summaries Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP screen which briefly describes the functions of selections 1 through 5.

2.8.2 View Events Menu

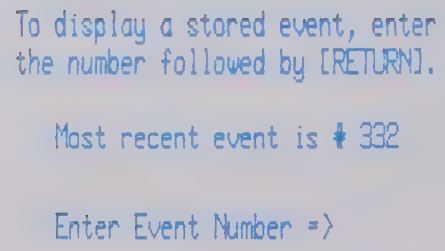
Selection 2 in the Main Menu puts you in the View Events Menu:



Possible Selections and What They Mean

Selection: **1 View Events by Number**

Application: Selection 1 immediately prompts you with a screen such as the following:



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You can either enter an event number and press <*Return*>, or simply press <*Return*> to display the last or most recent event. An event, such as the impulse in Figure 2-13, is displayed:

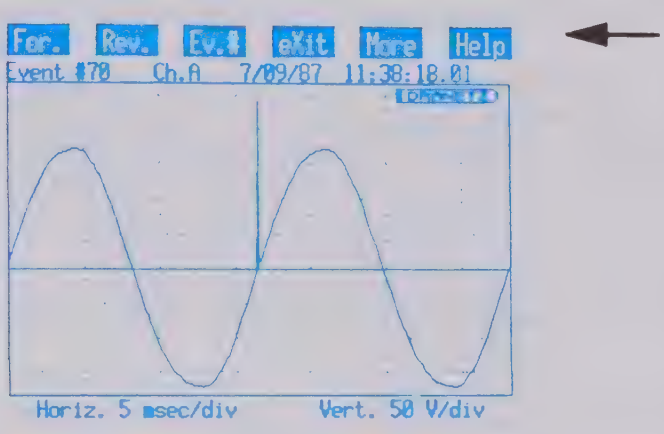

FIGURE 2-13. CAPTURED IMPULSE, FIRST SCREEN

NOTE

For Sensor channel events, only a text description of the event is displayed.

Text Line Below Screen

Horiz. 5 msec/div	Each division line as you go from left to right across the screen represents 5 milliseconds.
Vert. 50 V/div	Each division line as you go from the bottom to the top of the screen represents 50 volts (or amps, "A/div", with current).

Text Line Above Screen

Event #70	Indicates this is the 70th event in memory.
Ch.A	Indicates this is a picture of channel A data.
7/09/87	Indicates the date the disturbance occurred.
11:38:18.01	Indicates the time the disturbance occurred.

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Touch-Screen Buttons

For. Pressing this button on the touch-screen or the <*F*> key advances the display to the next channel that's on. After all channels for the event have been displayed, the screen advances to the next event in memory.

Rev. Pressing this button on the touch-screen or the <*R*> key brings you back to the previous "On" channel unless you are at channel A, in which case it brings you back to the previous event number.

Ev.# Pressing this button on the touch-screen or the <*E*> key puts you back to the Display a Stored Event Screen.

eXit Pressing this button on the touch-screen or the <*X*> key puts you back to the Main Menu.

More Pressing this button on the touch-screen or the <*M*> key displays the same waveform, but with the second set of touch-screen buttons displayed (see Figure 2-14).

Help Pressing this button on the touch-screen or the <*H*> key brings up an explanation of the touch-screen buttons and their equivalent keys.

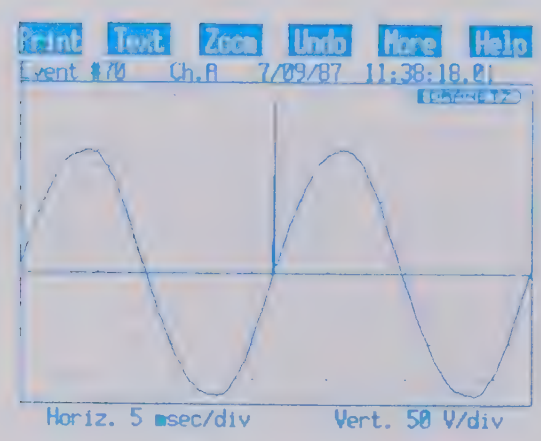

FIGURE 2-14. CAPTURED IMPULSE, SECOND SCREEN

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Print — Pressing this button on the touch-screen or the <*P*> key prints the displayed graph or text. Pressing the CANCEL button stops the printing.

Text — Pressing this button on the touch-screen or the <*T*> key gives you a description of the displayed disturbance.

Zoom — Pressing this button on the touch-screen or the <*Z*> key puts you in the "Zoom" mode, illustrated in Figure 2-15. An explanation of how you position the zoom-box follows the illustration.

Undo — After a waveform has been "zoomed," pressing this button on the touch-screen or the <*U*> key brings you back to the previous screen. This button performs no function until a waveform has been "zoomed."

More — Pressing this button on the touch-screen or the <*M*> key puts you back to the first screen (identical screen but with the first set of buttons displayed).

Help — Pressing this button on the touch-screen or the <*H*> key brings up an explanation of the touch-screen buttons and their equivalent keys.

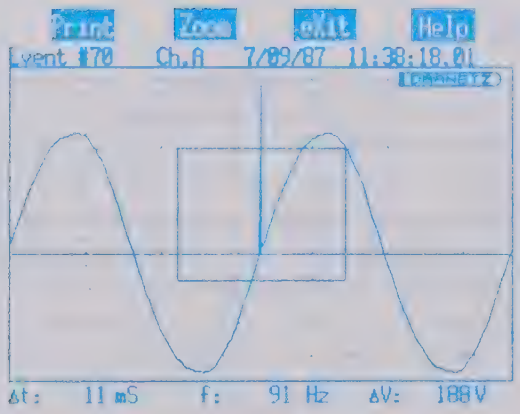

FIGURE 2-15. CAPTURED IMPULSE WITH ZOOM-BOX

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Text Line Below Screen

When you're at the previous screen, the text line below it changes to the following representations:

Δt:	11 mS	Indicates the width of the zoom-box.
f:	91 Hz	Indicates the frequency of a full cycle framed by the zoom-box.
ΔV:	188 V	Indicates the height of the zoom-box.

Touch-Screen Buttons

Print — Pressing this button on the touch-screen or the <*P*> key prints the displayed graph. Pressing the CANCEL button stops the printing.

Zoom — Pressing this button on the touch-screen or the <*Z*> key while the zoom-box is on the screen zooms in on the boxed off region. The region is then expanded to the full size of the screen. Positioning the zoom-box on the screen is explained below.

eXit — Pressing this button on the touch-screen or the <*X*> key brings you back to the original picture of the waveform, no matter how many times it was "zoomed."

Help — Pressing this button on the touch-screen or the <*H*> key gives you an explanation of your possible selections and what they mean.

Positioning the Zoom-Box

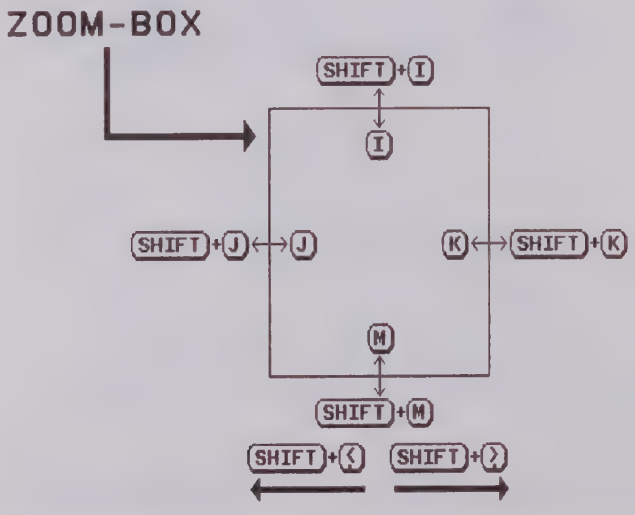

FIGURE 2-16. KEYBOARD COMMANDS FOR POSITIONING THE ZOOM-BOX

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Using the Zoom-Box to Estimate Disturbance Duration, Frequency, and Magnitude

You can continue to zoom in on the disturbance until you have enlarged it to a size where you can reasonably position the zoom-box around it to determine its duration, frequency, and magnitude.

Each time you position the zoom-box, you should position the sides as close as possible to the disturbance to maximize the area to be zoomed. Figure 2-17 illustrates a positioned zoom-box around a disturbance that has already been "zoomed" several times.

From the way the zoom-box is positioned, the text below the screen indicates that the impulse is approximately 12 microseconds, its frequency is approximately 41.5 kilohertz†, and its magnitude is approximately 242 volts. (These values are determined by the position of the walls of the zoom-box and change as you change its position; therefore, the closer you "wrap" the impulse with the zoom-box, the more accurate the readings will be.)

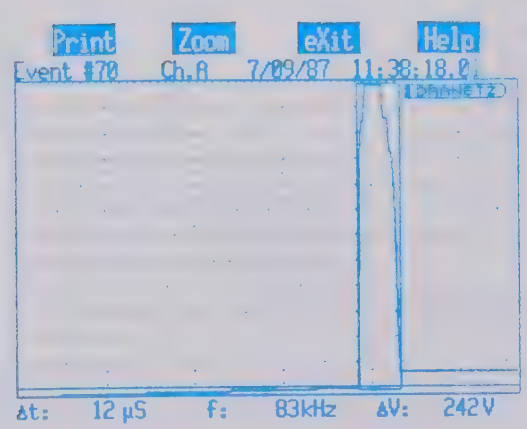

FIGURE 2-17. IMPULSE "ZOOMED" SEVERAL TIMES

†Since the zoom-box is framing a ½ cycle, the actual frequency would be ½ of 83 kilohertz or 41.5 kilohertz. The display frequency always assumes the zoom-box is framing a full cycle. If only a portion of a cycle is displayed (such as in Figure 2-17), you must multiply the displayed frequency by the fractional portion (in this case ½) of the waveform enclosed within the zoom-box.

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"Zoom" Increments

You could theoretically continue to zoom in on each waveform until you reach either the minimum time (Δt) or voltage/current (ΔV) increment: 25 μsec/division or 2 V/division. Once this point is reached, the 656 doesn't allow further zooms.

TABLE 2-1. TIME AND VOLTAGE INCREMENTS

Time Increments Per Division	Voltage/Current Increments Per Division
25 μsec	2 V or A
50 μsec	5 V or A
100 μsec	10 V or A
250 μsec	20 V or A
500 μsec	50 V or A
1000 μsec	100 V or A
2500 μsec	200 V or A
5000 μsec	500 V or A
5 msec	1000 V or A
10 msec	2000 V or A
25 msec	
50 msec	
100 msec	
250 msec	

Selection: **2 View Events by Time and Date**

Application: Selection 2 first prompts you for a date and then a time. The last event in memory which occurred before this time and date is then displayed.

Selection: **6 Return to MAIN MENU**

Application: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 and 2.

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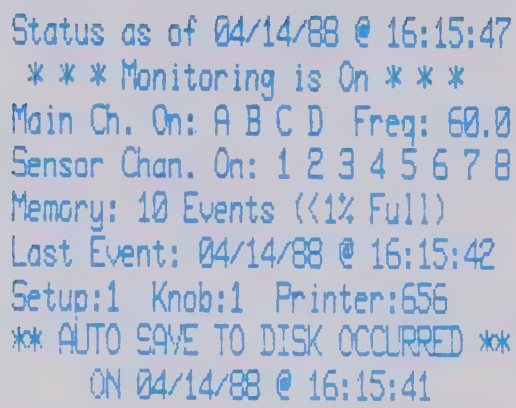
2.8.3 Status Screen

Selection 3 in the Main Menu brings up the Status Screen. An example of this screen appears below:


Status as of 04/14/88 @ 16:15:47
* * * Monitoring is On * * *
Main Ch. On: A B C D Freq: 60.0
Sensor Chan. On: 1 2 3 4 5 6 7 8
Memory: 10 Events (<1% Full)
Last Event: 04/14/88 @ 16:15:42
Setup:1 Knob:1 Printer:656
** AUTO SAVE TO DISK OCCURRED **
ON 04/14/88 @ 16:15:41

The Status Screen indicates:

- whether monitoring is on or off,
- what Main channels are on,
- the frequency of the Synchronization channel,
- what Sensor (Transducer) channels are on,
- the number of events in memory and the percentage of memory used,
- the date and time of the last recorded event,
- the active setup number,
- the SETUP knob position,
- the printer, and
- if an automatic save to disk function has just occurred, a message indicating its time and date appears (after you press any key, the message disappears and you return to the Main Menu).

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2.8.4 Monitoring Functions Menu

Selection 4 in the Main Menu brings up the Monitoring Functions Menu:

```
    Monitoring Functions Menu
1 Main Channel Setups
2 Sensor Channel Setups
3 Delete ALL Events in Memory
4 Turn Monitoring On/Off
5 Change Site Information
6 Return to the Status Screen
7 HELP !
```

Possible Selections and What They Mean

Selection: **1 Main Channel Setups**

Application: Selection 1 brings up the Main Channel Setups Screen:

```
1 Setup #01 A      B      C      D
2 Range     VH     Off    Off    VL


6 Imp.     0100 010.0 010.0 025.0
7 Wave      007  00.7  00.7  05.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

NOTE

When a line or selection is highlighted, if you press <Return> before making any changes, nothing on the screen is affected.

Only the setup matching the SETUP knob position is active when you first start out. For any additional setups you want to activate, you must go into the new setup number, make any changes, and press *<A>*.

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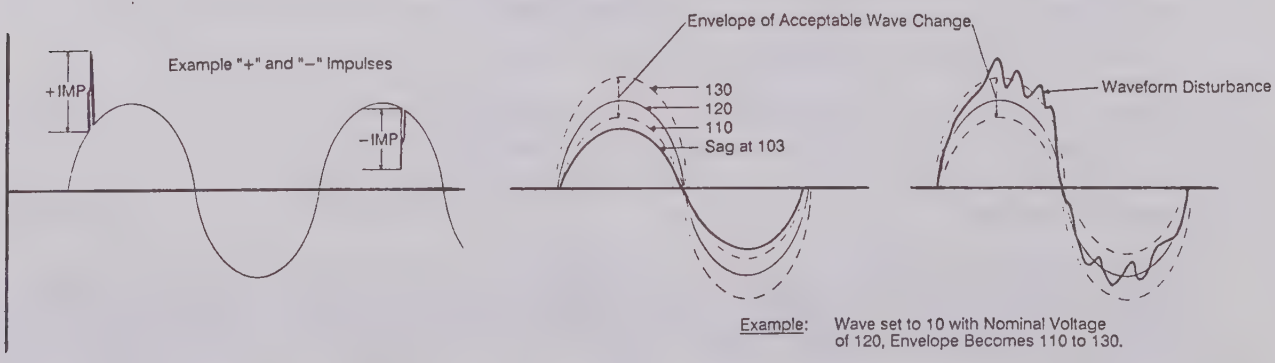
Pressing line 1 on the touch-screen or key <*1*> highlights the "Setup" line. You can change the setup using the numeric keys or by pressing the highlighted number on the touch-screen.

Pressing line 2 or key <*2*> lets you change the voltage or current range for each input channel. The highlighted channel letter on the touch-screen or keys <*A*> through <*D*> allow you to toggle between ranges. VH (voltage high range) is used for most line-to-line or line-to-neutral voltage monitoring. VL (voltage low range) is typically used for neutral-to-ground or low-voltage DC monitoring. The ranges for current are described in the table:

Vrms Range		Vpk Impulse Range		Waveform (Vrms) Envelope
VH = 0 to 724 Vrms	→	24 to 6120 V	→	2 to 724 V
VL = 0 to 72.4 Vrms	→	2.4 to 612 V	→	0.2 to 72.4 V
OFF = No Monitoring				
Arms Range (656A Only)		**Apk Impulse Range**		**Waveform (Arms) Envelope**
I5 = 0 to 7.24 Arms*	→	0.24 to 25 A	→	0.02 to 7.24 A
I30 = 0 to 72.4 Arms	→	2.4 to 250 A	→	0.2 to 72.4 A
I300 = 0 to 724 Arms†	→	24 to 2500 A	→	2 to 724 A
I3K = 0 to 7240 Arms‡	→	240 to 25000 A	→	20 to 7240 A

Pressing line 6 or key <*6*> lets you select impulse thresholds. Pressing line 7 or key <*7*> lets you select the waveform envelope. The envelope setting determines the amount a waveform can change before a new disturbance event is recorded. Waveform disturbances can be the result of changes in the rms value of voltage or current ("sags" or "surges"), or the result of shorter sub-cycle disturbances, such as notching or harmonic distortion (see examples below). The value set for this threshold corresponds to the ΔV (rms) or ΔI (rms) change determining the size of the envelope. Pressing line 8 or key <*8*> lets you select the threshold for change in frequency across all channels.

For selections 6, 7, and 8, press <*H*> while the selection is displayed to list the acceptable range. Once you have made new setup values, press <*A*> to activate the setup. Below are two example impulses on the left. On the right is an example sag with the waveform envelope set to 10 Vrms and a waveform disturbance with the same envelope:



*Use the 0-5A isolated CT Termination Box (110635-G2) with any 0-5A secondary probe in this range.

†Only use the TR-2019A current probe in this range.

‡Only use Dranetz P/N 110639-G2 (CT Termination box and 3000A current probe) in this range.

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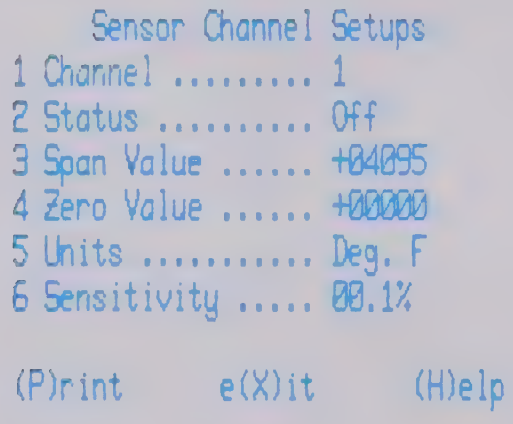
NOTE

Whenever you change a setup, you must press <A> to activate it. If you don't press <A>, the settings of the old Setup Screen remain.

Selection: **2 Sensor Channel Setups**

Application: Selection 2 brings up the Sensor Channel Setups Screen:



NOTE

When a line or selection is highlighted, if you press <Return> before making any changes, nothing on the screen is affected.

Pressing line 1 on the touch-screen or *<1>* highlights the "Channel" line. You can then use the keyboard keys to change the setup number or repeatedly press the number on the touch-screen. Each time you change the setup number, the entire screen changes to the new Setup Screen. Press *<Return>* to accept the value.

Pressing line 2 on the touch-screen or *<2>* highlights the "Status" line. You can then press any keyboard letter to toggle the reading "On" and "Off." You can also do the same by pressing the highlighted section of the touch-screen. Press *<Return>* to accept the displayed reading.

Pressing line 3 on the touch-screen or *<3>* highlights the "Span Value" line. You can then use the keyboard keys to change the span value, pressing *<Return>* to accept the value (press *<H>* for the acceptable range). Span value is described in the third paragraph on the following page.

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Pressing line 4 on the touch-screen or *<4>* highlights the "Zero Value" line. You can then use the keyboard keys to change the zero value, pressing *<Return>* to accept the value (press *<H>* for the acceptable range). Zero value is described in the third paragraph.

Pressing line 5 on the touch-screen or *<5>* highlights the "Units" line. You can then use the keyboard keys to change the units description. Press *<Return>* to accept the display. "Units" is described in the following paragraph.

Span value and zero value are used with the "Units" description to fit the voltage output of the input transducer to a linear equation and to generate appropriate engineering units. Span refers to the nearest integer engineering units output of a transducer at the full scale (10 volts) of the input. The zero value refers to the nearest integer engineering units output of a transducer at 0 volts of the input. Span and zero value setups are signed integers ranging from −32,768 to 32,768.

Pressing line 6 on the touch-screen or *<6>* highlights the "Sensitivity" line. You can then use the keyboard keys to change the sensitivity value, entering a decimal point between the second and third digits, if necessary (press *<H>* for the acceptable range). Press *<Return>* to accept the value.

You can press *<P>* to print the screen, press *<X>* to exit back to the Monitoring Functions Menu, or press *<H>* to bring up a HELP Screen describing your possibilities.

Selection: **3 Delete ALL Events in Memory**

Application: Selection 3 first brings up a confirmation screen verifying this selection (you may want to save your current events to disk before erasing them). If you respond by pressing *<Y>*, all events in memory are erased. If event scanning is on, new reference events are immediately recorded.

CAUTION

Once the events have been erased, THEY CAN NEVER BE RECOVERED.

Selection: **4 Turn Monitoring On/Off**

Application: Selection 4 brings up a message indicating either that event scanning is on and would you like to turn it off, or that event scanning is off and would you like to turn it on. If scanning is off and you want to turn it on, you are prompted to enter the setup number for monitoring.

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NOTE

Event Scanning is automatically turned off when 656 memory is full. Memory is full when there is not enough room to store a worst case event. If an initialized disk is in the left disk drive, events are automatically dumped to disk, freeing up memory for more events.

Selection: **5 Change Site Information**

Application: Selection 5 brings up a message asking you if you want to change the current site information. If you press <*Y*>, you can enter up to a 42 character description, followed by <*Return*>. Once you have changed the site information, all events recorded by the 656 from that time on have the name of the new site. For your record keeping, change the site information whenever you begin recording events from a different site.

Selection: **6 Return to the Status Screen**

Application: Selection 6 brings up the current Status Screen. Pressing any key then brings you back to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 5.

2.8.5 Disk Operations Menu

Selection 5 in the Main Menu brings up the Disk Operations Menu:

```
        Disk Operations Menu
1 Get Information From Disk...
2 Save Information to Disk...
3 Initialize a New Disk
4 Make a Duplicate Disk

6 Return to MAIN MENU
7 HELP !
```

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Possible Selections and What They Mean

Selection: **1 Get Information From Disk**

Application: Selection 1 lets you load events and setups stored on a disk into 656 memory. Selection 1 prompts you to place the disk to be loaded into the left disk drive and to press any key. The disk is loaded in less than 1 minute. If no disk is inserted within 10 seconds, the 656 returns to the Main Menu.

Selection: **2 Save Information to Disk**

CAUTION

All of the current data on the destination disk is destroyed when you use this selection.

Application: Selection 2 lets you save events, setups, or both to disk. Refer to Subsection 2.8.5.1 for information on this selection.

Selection: **3 Initialize a New Disk**

Application: Selection 3 lets you initialize a new disk. A disk must be initialized before any information can be stored on it. You are prompted to insert the disk to be initialized into the left disk drive and to press <*Y*> to begin. Initialization takes about 2 minutes. If you press <*N*>, initialization is aborted.

NOTE

The format of the initialized disk is not the same format as your personal computer produces.

Selection: **4 Make a Duplicate Disk**

Application: Selection 4 lets you make a duplicate copy of a disk. You are prompted to insert the source disk (disk with the original copy) into the right disk drive and to insert an initialized destination disk (the disk want the copy to be on) into the left disk drive.

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Selection: **6 Return to MAIN MENU**

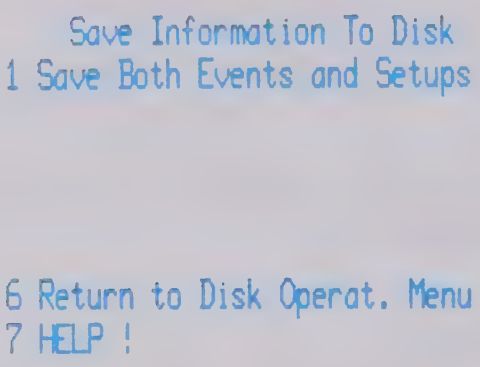
Application: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

2.8.5.1 Save Information to Disk Menu

Selection 2 in the Disk Operations Menu brings up the Save Information to Disk Menu:



Possible Selections and What They Mean

Selection: **1 Save Both Events and Setups**

Application: Selection 1 lets you save both the events and setups in 656 memory to a disk. You are prompted to insert the destination disk in the left drive and to press <*Y*>.

Selection: **6 Return to Disk Operat. Menu**

Application: Selection 6 returns you to the Disk Operations Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 3.

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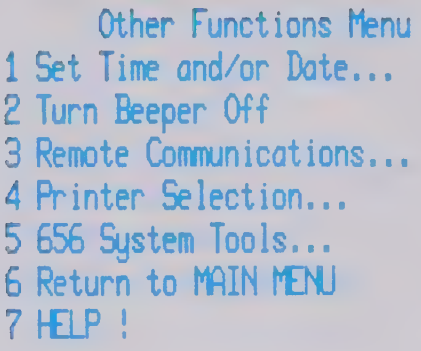
2.8.6 Other Functions Menu

Selection 6 in the Main Menu brings up the Other Functions Menu:



Possible Selections and What They Mean

Selection: **1 Set Time and/or Date**

Application: Selection 1 brings up a screen which prompts you for a new time and date for the internal clock. Time must be entered in 24-hour military format and date must be entered in mm/dd/yy format.

Selection: **2 Turn Beeper Off (On)**

Application: Selection 2 toggles the beeper "Off" and "On". When the beeper is on, it sounds whenever an event is recorded.

Selection: **3 Remote Communications**

Application: Selection 3 lets you perform various remote communications. Refer to Subsection 2.8.6.1 for information on this selection.

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Selection: **4 Printer Selection**

Application: Selection 4 lets you change the default printer setup from the built-in printer to one of the following supported external printers connected to the Auxiliary Port:

- Hewlett-Packard ThinkJet
- Epson LX-800
- Okidata ML-192
- Apple Imagewriter

The screen prompts you for your responses. **Note**: Data is transmitted through the Auxiliary Port at 9600 baud with 8 data bits, 1 start-bit, and no parity or handshaking.

Selection: **5 656 System Tools**

Application: Selection 5 lets you access the 656 system tools. Refer to Subsection 2.8.6.2 for more information on this selection.

Selection: **6 Return to MAIN MENU**

Application: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 5.

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2.8.6.1 Remote Communication Menu

Selection 3 in the Other Functions Menu brings up the Remote Communication Menu:

Modem Communication†

Local (Direct Wiring) Communication

```
Remote Communication Menu
1 Wait for a Call
2 Initiate a Call...
3 Start Non-Modem Receive...
4 Start Non-Modem Transmit
5 Change Baud Rate...
6 Return to Previous Menu
7 HELP!
```

Possible Selections and What They Mean (Remote Communication Menu)

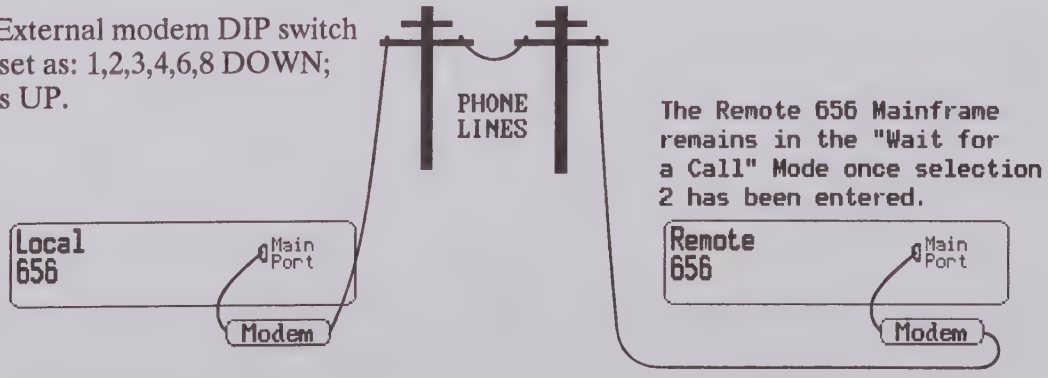
NOTE

Hold down <Ctrl> and press the <X> key twice to terminate communication with the remote 656 at any time. If using selection 1, follow the dialing instructions of your modem, being sure to press <T> for tone dialing, <P> for pulse dialing, a comma for the wait-for-dial-tone pause, and so forth.

Selection: **1 Wait for a Call** (Remote Communication Menu)

Application: Selection 1 prompts you to connect the modem to the 656 Main Port (or connect the phone line directly to the internal modem option if installed) and to press any key for initialization. After several seconds, the modem is initialized and the 656 remains in the "Wait for a Call" Mode where it awaits a call while continuing to monitor for events. Holding down <*Ctrl*> while pressing <*X*> twice aborts this mode.

NOTE: External modem DIP switch *must* be set as: 1,2,3,4,6,8 DOWN; all others UP.



†Selections 1 and 2 require the internal modem option or a Hayes Smartmodem 1200 (or compatible).

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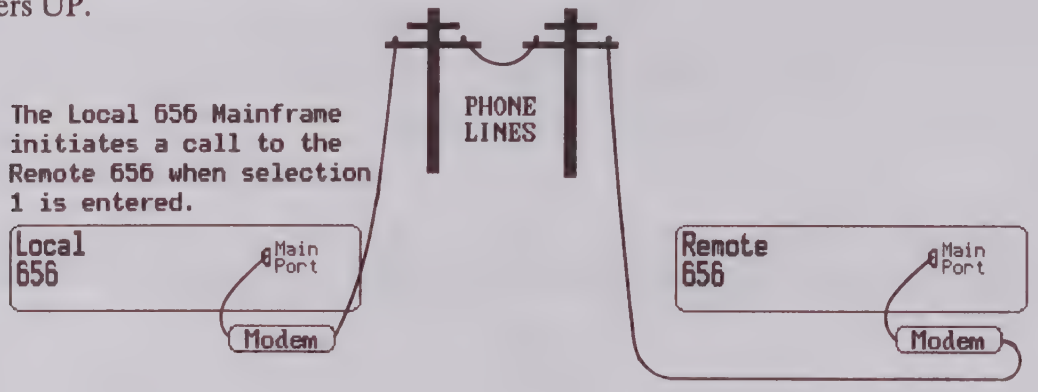
Selection: **2 Initiate a Call** (Remote Communication Menu)

Application: Selection 2 prompts you to connect the modem (or connect the phone line directly to the internal modem option if installed) to the 656 Main Port and to press any key for initialization. Once the modem is initialized, you are prompted to enter the telephone number of the remote 656 you are calling.

NOTE: External modem DIP switch *must* be set as: 1,2,3,4,6,8 DOWN; all others UP.



As long as the remote 656 you are calling through a modem is in the "Wait for a Call" Mode (selection 1 has been entered), it answers on the second ring. The Remote Interface Menu then appears:

```
  Remote Interface Menu
1 Get Status Screen...
2 Get Graphic Summaries...
3 Change Setups...
4 Transfer All Events
5 Delete All Events
6 End Communications
7 HELP !
```

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Possible Selections and What They Mean (Remote Interface Menu)

Selection: **1 Get Status Screen** (Remote Interface Menu)

Application: Selection 1 instructs the remote 656 to send its status information. A Status Screen such as the following appears:

```
* * * Remote 656's Status * * *
Monitoring: On Active Setup: 1
Main Channels Used: A D
Memory: 8 Events (<1% Full)
Site Info: DRANETZ 656 Disturbance Waveform Analyzer
5 Activate a Setup
6 Return to Interface Menu
7 HELP !
```

From the Status Screen, selection 1, "Activate a New Setup", lets you select a setup number and then activate the selected setup in the remote 656. Selection 2 returns you to the Remote Interface Menu, and selection 3 brings up a HELP Screen.

Selection: **2 Get Graphic Summaries** (Remote Interface Menu)

Application: Selection 2 instructs the remote 656 to send a graphic summary plot and text description to the local 656, as defined by the Graphic Summaries Menu. The Graphic Summaries Menu appears:

```
     Graphic Summaries Menu
1 Plot RMS/Impulse Summary
2 Plot Frequency Summary
3 Plot Sensor Channel Summary


6 Return to Main Menu
7 HELP !
```

Selections 1, 2, 3, in the Graphic Summaries Menu are described in Subsections 2.8.1.1, 2.8.1.2, and 2.8.1.3. Selection 6 returns you to the Remote Interface Menu. Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 3.

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Selection: **3 Change Setups** (Remote Interface Menu)

Application: Selection 3 instructs the remote 656 to send its Main and Sensor Channel setups. After transmission, the local 656 enters the Monitoring Functions Menu:

```
    Monitoring Functions Menu
1 Main Channel Setups
2 Sensor Channel Setups
3 Delete ALL Events in Memory
4 Turn Monitoring On/Off
5 Change Site Information
6 Return to the Status Screen
7 HELP !
```

Main Channel setups are edited through Selection 1; Sensor Channel setups are edited through selection 2. When exiting the editing mode (selection 6, "Return to the Status Screen"), you are given the option of sending the revised setups back to the remote 656. Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 6.

Selection: **4 Transfer All Events** (Remote Interface Menu)

Application: Selection 4 instructs the remote 656 to send all of its events and setup information to the local 656.

Selection: **5 Delete All Events** (Remote Interface Menu)

Application: Selection 5 instructs the remote 656 to delete all events in memory.

Selection: **6 End Communication** (Remote Interface Menu)

Application: Selection 6 terminates communication with the remote 656. The remote 656 regains control and use of its keyboard and touch-screen.

Selection: **7 HELP !** (Remote Interface Menu)

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 6.

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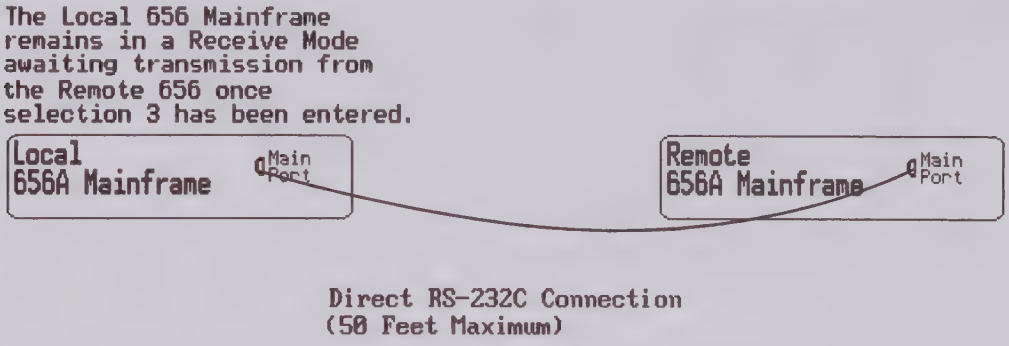
Possible Selections and What They Mean (Remote Communication Menu Cont'd)

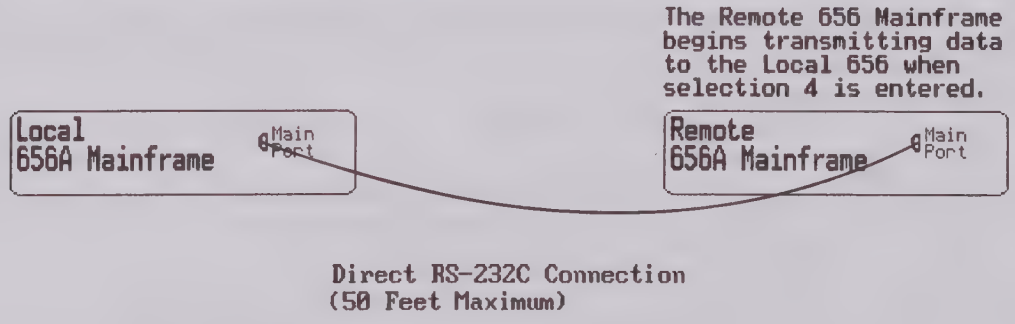
Selection: **3 Start Non-Modem Receive** (Remote Communication Menu)

Application: Selection 3 puts your 656 in an immediate Receive Mode where it awaits the connected 656 to begin transmitting data. **Note**: This selection only applies to direct connect systems, not modem connections.



Selection: **4 Start Non-Modem Transmit** (Remote Communication Menu)

Application: Selection 4 puts your 656 in an immediate Transmit Mode where it begins transmitting to the connected 656 waiting in the Receive Mode. **Note**: This selection only applies to direct connect systems, not modem connections.



After the selection is made, the Remote Interface Menu appears:

```
  Remote Interface Menu
1 Get Status Screen...
2 Get Graphic Summaries...
3 Change Setups...
4 Transfer All Events
5 Delete All Events
6 End Communications
7 HELP !
```

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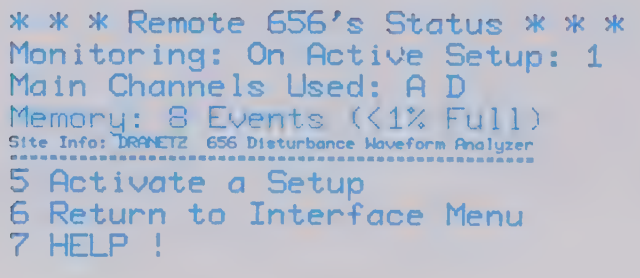
Possible Selections and What They Mean (Remote Interface Menu)

Selection: **1 Get Status Screen** (Remote Interface Menu)

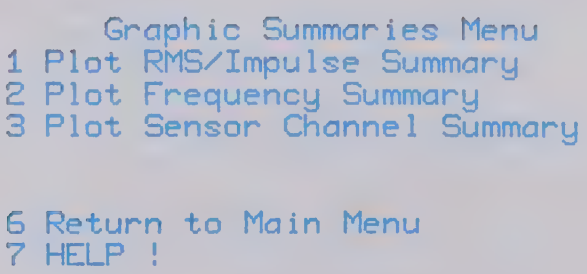
Application: Selection 1 instructs the remote 656 to send its status information. A Status Screen such as the following appears:


* * * Remote 656's Status * * *
Monitoring: On Active Setup: 1
Main Channels Used: A D
Memory: 8 Events (<1% Full)
Site Info: DRANETZ 656 Disturbance Waveform Analyzer
5 Activate a Setup
6 Return to Interface Menu
7 HELP !

From the Status Screen, selection 1, "Activate a New Setup", allows you select a setup number and then activate the selected setup in the remote 656. Selection 2 returns you to the Remote Interface Menu, and selection 3 brings up a HELP Screen.

Selection: **2 Get Graphic Summaries** (Remote Interface Menu)

Application: Selection 2 instructs the remote 656 to send a graphic summary plot and text description to the local 656, as defined by the Graphic Summaries Menu. The Graphic Summaries Menu appears:


Graphic Summaries Menu
1 Plot RMS/Impulse Summary
2 Plot Frequency Summary
3 Plot Sensor Channel Summary
6 Return to Main Menu
7 HELP !

Selections 1, 2, 3, in the Graphic Summaries Menu are described in Subsections 2.8.1.1, 2.8.1.2, and 2.8.1.3. Selection 6 returns you to the Remote Interface Menu. Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 3.

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Selection: **3 Change Setups** (Remote Interface Menu)

Application: Selection 3 instructs the remote 656 to send its Main and Sensor Channel setups. After transmission, the local 656 enters the Monitoring Functions Menu:

```
    Monitoring Functions Menu
1 Main Channel Setups
2 Sensor Channel Setups
3 Delete ALL Events in Memory
4 Turn Monitoring On/Off
5 Change Site Information
6 Return to the Status Screen
7 HELP !
```

Either Main or Sensor Channel setups can be edited through Selection 1 or 2 of the Monitoring Functions Menu. When exiting the editing mode, you are given the option of sending the setups back to the remote 656.

Selection: **4 Transfer All Events** (Remote Interface Menu)

Application: Selection 4 instructs the remote 656 to send all of its events and setup information to the local 656.

Selection: **5 Delete All Events** (Remote Interface Menu)

Application: Selection 5 instructs the remote 656 to delete all events in memory.

Selection: **6 End Communication** (Remote Interface Menu)

Application: Selection 6 terminates communication with the remote 656. The remote 656 regains control and use of its keyboard and touch-screen.

Selection: **7 HELP !** (Remote Interface Menu)

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 6.

Possible Selections and What They Mean (Remote Communication Menu Cont'd)

Selection: **5 Change Baud Rate** (Remote Communication Menu)

Application: This selection brings up a baud rate screen where you can change the Main Port baud rate setting for the internal 656 modem option or an external modem.

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Possible Selections and What They Mean (Remote Communication Menu Cont'd)

Selection: **6 Return to Previous Menu** (Remote Communication Menu)

Application: This selection returns you to the Other Functions Menu.

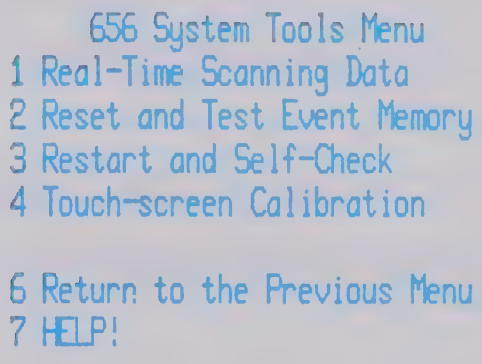
Selection: **7 HELP !** (Remote Communication Menu)

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

2.8.6.2 656 System Tools Menu

Selection 5 from the Other Functions Menu brings up a prompt for the access code to get into the 656 System Tools Menu. The access code is **DRAN**.

Type *DRAN* and then press *<Return>*. The 656 System Tools Menu appears:


656 System Tools Menu
1 Real-Time Scanning Data
2 Reset and Test Event Memory
3 Restart and Self-Check
4 Touch-screen Calibration
6 Return to the Previous Menu
7 HELP!

Possible Selections and What They Mean

Selection: **1 Real-Time Scanning Data**

Application: Refer to Volume 2 of this manual. This selection is applicable to the maintenance of the 656, not its operation.

Selection: **2 Reset and Test Event Memory**

Application: Selection 2 prompts you to verify the selection by pressing *<Y>*. If you do so, all of the stored events are erased and the setups return to their original factory settings.

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NOTE

You MUST recalibrate the touch-screen, using selection 4, after returning from selection 2.

Selection: **3 Restart and Self-Check**

Application: Selection 3 resets the 656 (similar to turning the instrument off and then on) and runs the initial diagnostics self-test.

Selection: **4 Touch-Screen Calibration**

Application: Selection 4 lets you calibrate the touch-screen. After making this selection you are prompted on the screen with the appropriate procedures to follow.

Selection: **6 Return to the Previous Menu**

Application: Selection 6 returns you to the Other Functions Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

2.9 MISCELLANEOUS DISK FUNCTIONS

- The 656 automatically saves events to a disk when its memory fills up. To take advantage of this feature, an initialized and unprotected disk (window closed) must remain in the left drive during monitoring.

- During any disk operations (saving information to disk, getting information from disk, initializing a new disk, and duplicating a disk), the 656 suspends all monitoring. Monitoring immediately resumes when the disk operation is completed, and any events occurring while monitoring is suspended are held in a buffer and recorded when the disk operation concludes.

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SECTION III
OPERATIONAL TESTS

3.1 GENERAL

The 656 automatically performs a diagnostics self-test each time it is turned on. The results of the test are indicated on the Start-Up Screen. The self-test checks the integrity of the following sections:

- CRT Display RAM
- Front Panel Interface Program RAM
- Event Memory
- Front End Processor Data RAM
- Extended Memory

3.1.1 If All Tests PASS

If no malfunctions are detected, the initial Start-Up Screen displays "PASSED" for the four tests and you are ready to proceed.

3.1.2 If Malfunction(s) Detected

Any malfunctions detected are listed descriptively along with what action you should take.

NOTE

Refer to Appendix A for a listing of the possible hardware/software error messages and the actions you should take.

You should then go to Subsection 1.11 (FACTORY REPAIR) for further instructions on contacting Dranetz Customer Service Department before returning the unit for repair.

3.2 CALIBRATION

The recommended calibration interval for the 656 is every **12 MONTHS**.

We recommend that you return the unit to Dranetz Customer Service Department for calibration. If you decide to do so, first contact Dranetz to obtain an authorization number:

Telephone Number: (201) 287-3680
Telex Number: 499-7808
TWX Number: (710) 997-9553

FAX Number: (201) 248-9240
Cable: DRANETZ

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Then fill out the REPAIR/SERVICE ORDER form enclosed in this manual and ship it along with the unit to Dranetz Customer Service Department. (If this form is missing, ask Dranetz for a replacement.)

3.2.1 Battery Pack Replacement

The 656 contains an internal battery pack. For optimal use and reliability, we recommend that you have the battery pack replaced every **2 YEARS**.

Replacement is performed by Dranetz Customer Service Department by following the same procedure described in Subsection 3.2.

3.2.2 Touch-Screen Calibration

If the touch-screen is not functioning properly, or if you believe the touch-screen has lost its accuracy, you should calibrate it. Follow the instructions in this manual to select the 656 System Tools Menu (see Subsection 2.8.6.2). From the System Tools Menu, select Touch-Screen calibration and follow the prompts for the appropriate procedures.

3.3 CALIBRATING THE MAIN & SENSOR (TRANSDUCER) CHANNELS

The recommended interval for calibrating the Main channels and Sensor (Transducer) channels is every **12 MONTHS**. Refer to Volume 2 for instructions or call Dranetz (see Subsection 1.11).

3.3.1 Calibrating the Sensor (Transducer) Channel Monitors

If you have purchased any or all of the available Sensor channel monitors, refer to the appropriate tabbed sections that follow for information regarding the calibration of the Sensor channel Monitors.

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656-XD-1001 TEMPERATURE & HUMIDITY MONITOR

SCOPE

This portion of your manual contains the installation, programming, operating, and calibration instructions for the Dranetz Model 656-XD-1001 Temperature & Humidity Monitor, referred to from here on as the "T&H Monitor." This section applies to you if you have purchased or intend to purchase the T&H Monitor option.

PURPOSE

Computers, peripherals, and other electronic equipment are highly sensitive to variations in temperature and humidity. It is therefore important to continuously monitor the environment of such equipment to maintain its integrity. Manufacturers typically recommend that ambient temperature be kept between 18 and 24 degrees Celsius and relative humidity be kept between 40 and 60 percent. Excessive temperature variations and low humidity around some electronic equipment can cause component failures; excessive humidity can damage magnetic storage media and inhibit printer operation.

APPLICATIONS

The T&H Monitor lets you monitor temperature (−5° to 55°C; 23° to 131°F) and humidity (0 to 100% RH) at the 656 site. The 656 Sensor Channel Setups menu lets you select any sensitivity you desire. The Monitor is small (about 1 by 3 by 4 inches) and light (5 ounces). The T&H Monitor's 9-foot cable lets you mount it on a horizontal or vertical surface.

If the initial storage memory of the 656 is empty, the 656 can store a combined total of over 17,000 temperature and humidity events.

POWER REQUIREMENTS

The T&H Monitor is powered by its own 120V AC adapter which plugs into any 90 to 130V AC, 60 Hz, 3-pronged outlet.

TRANSDUCER BOARD FACTORY PRESET VOLTAGE SETTING

The 656 Transducer Board is factory preset by an internal jumper to monitor voltage. This **MUST** be the setting to use the T&H Monitor, and if you have changed the jumper setting to monitor current, change it back before proceeding (refer to Volume 2).

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T&H MONITOR KIT CONTENTS

Verify that you have received the following contents with your T&H Monitor Kit:

- T&H Monitor with 9' extension cable attached
- 120V AC Adapter
- 1' signal cable (P/N 113802-G1) with a connector end

IF THE T&H MONITOR KIT IS DAMAGED

If any of the above listed equipment is damaged, use the original packing case and materials to return the T&H Monitor to Dranetz Customer Service Department. However, before returning any equipment, file an insurance claim with your underwriter or carrier or both, and then call Dranetz for a return authorization number:

Tel: (201) 287-3680
FAX: (201) 248-9240
TWX: (201) 997-9553
Telex: 499-7808
Cable: DRANETZ

After you receive an authorization number, fill out the REPAIR/SERVICE ORDER form in the back of this manual and ship it along with the T&H Monitor to Dranetz Customer Service Department. (If this form is missing, request a replacement from Dranetz.)

OPTIONAL EXTENSION CABLE ACCESSORY

An optional 90' extension cable is available for the T&H Monitor. The extension cable lets you monitor temperature and humidity up to 100 feet away from the 656 Mainframe. To request this accessory, contact Dranetz Order Entry Department and order part number 113804-G1.

Dranetz Technologies, Inc.
1000 New Durham Road
P.O. Box 4019
Edison, NJ 08818-4019
(201) 287-3680

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TECHNICAL SPECIFICATIONS

TABLE 1001-1. T&H MONITOR SPECIFICATIONS

PHYSICAL	
Size	3.3" x 4.3" x 1.3" (85 x 110 x 32 mm)
Weight	5 ounces (142 grams)
Housing	ABS Plastic
Connections	9' shielded cable
POWER SUPPLY	
Input	90 to 130V AC, 60 Hz
Output	24V DC, 50 mA
OPERATING RANGES AND ACCURACY	
Operating Temperature	−5° to 55°C (23° to 131°F)
Accuracy	±1°C
Measuring Range	0 to 100% RH
Accuracy	±2.5% RH (from 0 to 90% RH) ±3.5% RH (from 90 to 100% RH)
Temperature Coefficient	0.04% RH per °C (typically)
Output	0 to 10 V DC
OPTIONAL ACCESSORY	
Extension cable (P/N 113804-G1)	90' shielded cable with snap on/off connectors on each end

CONNECTING THE MONITOR TO THE 656 TRANSDUCER BOARD

The 656 Sensor (Transducer) Board and strip must be installed in the 656 Mainframe in order to use the T&H Monitor.

WARNING

Verify that any monitored lines and the 656 are off and that the T&H Monitor is unplugged before proceeding with connections. Because of possible shock or fire hazards, connection should be performed in compliance with the National Electric Code (ANSI C1) and any other applicable requirements. Installing, operating, and maintaining this unit should only be performed by qualified individuals. At the time of this writing, Underwriters Laboratories, Inc. has determined that a qualified person is self-determined by the individual attempting to perform the task.

1. Unplug the T&H Monitor.

2. Turn the 656 off, but leave it plugged in to maintain a safety ground.

3. Gently snap off the green 656 Sensor (Transducer) Channel strip from its board and connect the colored wires of the 1' cable to the strip as follows:

   - White wire to Terminal "1+"
   - Black wire to Terminal "1−"
   - Red wire to Terminal "2+"

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- Green wire to Terminal "2−"
- Long green wire with spade connector to the ground terminal of Main channel A (ground lug as in illustration below for 656A or screw terminal for 656)

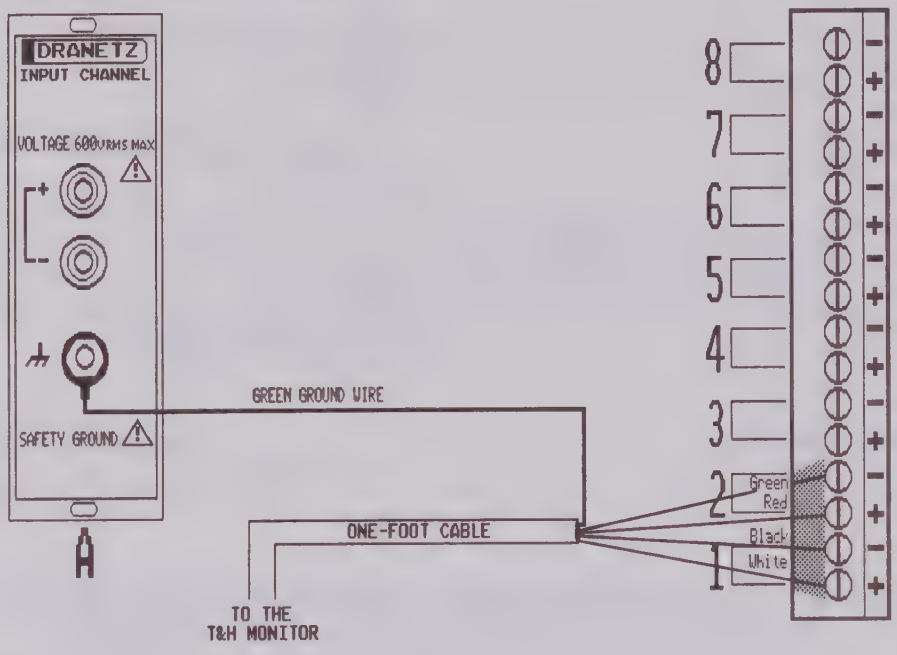

FIGURE 1001-1.

WIRING THE T&H MONITOR

4. Snap the Sensor (Transducer) channel strip with connected wires back on the board.

5. Plug the connector end of the 1' cable into the connector end of the 9' cable and twist it into place. **Note**: If you are using the 90' extension cable, connect this cable between the 1' and 9' cables.

6. You can mount the T&H Monitor on a horizontal or vertical surface, or you can hang it up by looping a wire around its top rear panel slot.

   If you want to secure the T&H Monitor to a surface, screw in two #4 screws, 2½" apart on the mounting surface, leaving the heads of the screws protruding about ¼" from the surface. Place the rear panel slots of the T&H Monitor over the protruding screws and slide it slightly to the left to lock it into place.

7. Verify that all connections are secure, and then plug in the T&H Monitor's 120V AC adapter and turn the 656 on.

TEMPERATURE AND HUMIDITY MONITORING

You have now connected temperature sensing to Sensor channel S1 and humidity sensing to Sensor channel S2. You must now program channels S1 and S2 to reflect temperature and humidity monitoring (refer to selection 2 under Subsection 2.8.4).

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Below are two example Sensor Channel setups for Sensor channel S1. The left example represents a Celsius setup and the right example represents a Fahrenheit setup:

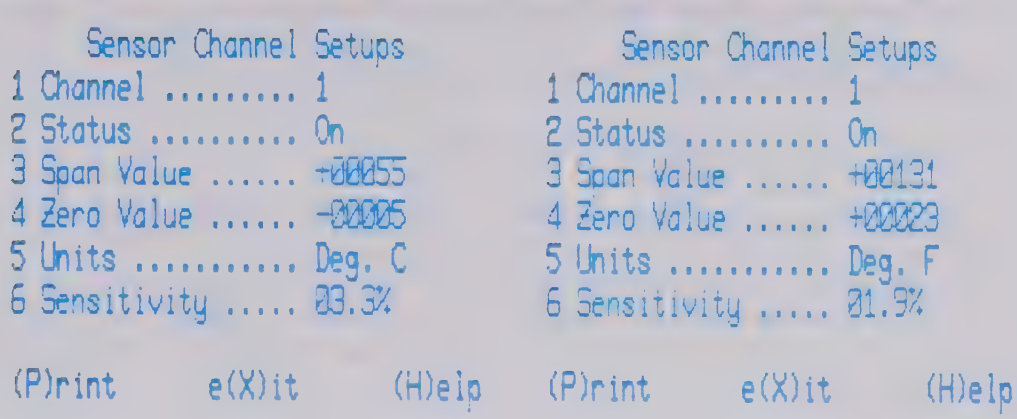
Sensor Channel Setups
1 Channel 1
2 Status ..... On
3 Span Value ..... +00055
4 Zero Value ..... -00005
5 Units ..... Deg. C
6 Sensitivity 03.3%
(P)rint e(X)it (H)elp
Sensor Channel Setups
1 Channel 1
2 Status ..... On
3 Span Value ..... +00131
4 Zero Value ..... +00023
5 Units ..... Deg. F
6 Sensitivity 01.9%
(P)rint e(X)it (H)elp

Table 1001-2 indicates what percentage you should program under selection 6 to obtain the indicated Celsius or Fahrenheit sensitivities. Use the table for common sensitivities listed, however, use the formula (top of next page) if you desire other degree sensitivities.

TABLE 1001-2. COMMON CELSIUS & FAHRENHEIT SENSITIVITIES

Celsius Sensitivities		**Fahrenheit Sensitivities**	
For Sens. of:	Program Pctg:	For Sens. of:	Program Pctg:
0.5°C	00.8%	0.5°F	00.5%
1.0°C	01.7%	1.0°F	00.9%
1.5°C	02.5%	1.5°F	01.4%
2.0°C	**03.3%†**	2.0°F	01.9%
2.5°C	04.2%	2.5°F	02.3%
3.0°C	05.0%	3.0°F	02.8%
3.5°C	05.8%	3.5°F	03.2%
4.0°C	06.7%	4.0°F	03.7%
4.5°C	07.5%	4.5°F	04.2%
5.0°C	08.3%	5.0°F	04.6%
5.5°C	09.2%	5.5°F	05.1%
6.0°C	10.0%	6.0°F	05.6%
6.5°C	10.8%	6.5°F	06.0%
7.0°C	11.7%	7.0°F	06.5%
7.5°C	12.5%	7.5°F	06.9%
8.0°C	13.3%	8.0°F	07.4%
8.5°C	14.2%	8.5°F	07.9%
9.0°C	15.0%	9.0°F	08.3%
9.5°C	15.8%	9.5°F	08.8%
10°C	16.7%	10°F	09.3%

†Factory preset value.

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The formula used to derive the percentage values in the previous chart is:

Event Sensitivity = Sensitivity x (Span Value − Zero Value)

In example 1: 2.0°C Sensitivity = **03.3%** x (55 − (−5))

In example 2: 2.0°F Sensitivity = **01.9%** x (131 − 23)

Below is an example setup for Sensor channel S2. When setting up S2, follow the example below, adjusting the sensitivity percentage to correspond to the event sensitivity you desire. The sensitivity percentage corresponds directly to the humidity variance required for a humidity event to be recorded. For example, 2% indicates that humidity must change by at least 2% for an event to be recorded, 3.5% indicates it must change by 3.5% for an event to be recorded, and so forth.

```
     Sensor Channel Setups
1 Channel ..... 2
2 Status ..... On
3 Span Value ..... +00100
4 Zero Value ..... +00000
5 Units ..... % RH
6 Sensitivity ..... 02.0%

(P)rint      e(X)it      (H)elp
```

Once Sensor channels S1 and S2 have been set up, you are nearly ready to begin temperature and humidity monitoring. As one final check, make sure the "Status" lines of Sensor channel screens "1" and "2" read "On" (refer to selection 2 in Subsection 2.8.4). Once the status for both setups is "On", turn the 656 off and then on again. This resets the unit, and when it comes on it captures an initial event for each Main and Sensor channel with status "On".

PLOTTING GRAPHIC SUMMARIES OF TEMPERATURE AND HUMIDITY EVENTS

From the 656 Main Menu you can plot a graphic summary of recorded temperature and humidity events. To do so, press *<1>* while in the Main Menu and then press *<3>* to plot a Sensor channel summary. Use selection 1 to choose the Sensor channel to be plotted: S1 for temperature events or S2 for humidity events. Then select the time span of the desired plot.

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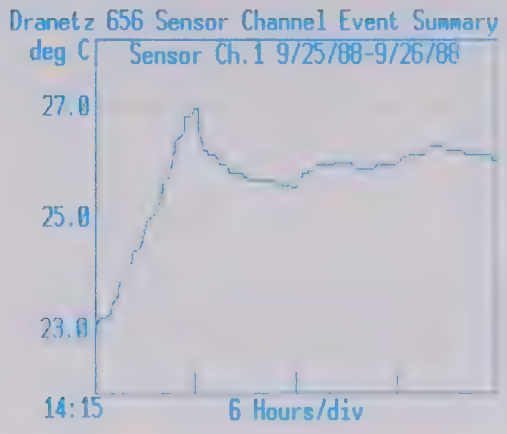
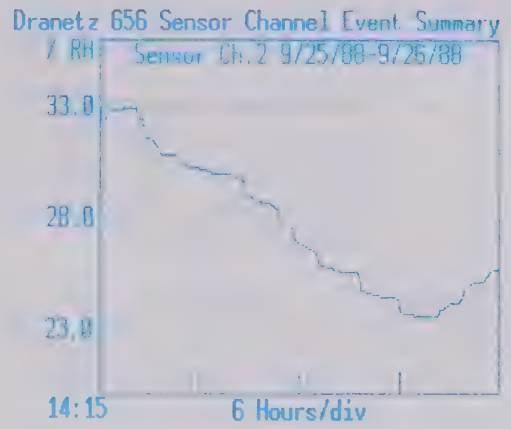
Below are two example Sensor channel plots of S1 (temperature) and S2 (humidity). These 24-hour plots were recorded from 2:15 p.m. on September 25, 1988 through 1:30 p.m. on September 26, 1988 (there was only 23¼ hours of data):





VIEWING TEMPERATURE AND HUMIDITY EVENTS

From the 656 Main Menu you can view the text of recorded temperature and humidity events by their order of occurrence or by their time and date of occurrence. To do so, press *<2>* while in the Main Menu and then press *<1>* to view events by number (of occurrence) or press *<2>* to view events by time and date (of occurrence). Some example temperature and humidity events are listed below (assume 2°C and 2% sensitivities):

Event #14 9/25/88 14:15:58.05

Sensor Channel S1 initial event
Value when setup activated = 22.75 deg. C

Event #15 9/25/88 14:15:58.15

Sensor Channel S2 initial event
Value when setup activated = 31.52% RH

Event #16 9/25/88 14:16:07.51

Sensor Channel S1 value changed
from 22.75 to 24.78 deg. C

Event #17 9/25/88 14:16:19:07

Sensor Channel S2 value changed
from 31.52 to 33.56% RH

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RETURNING THE T&H MONITOR FOR 6-MONTH FACTORY CALIBRATION

We recommend that you calibrate the T&H Monitor every **6 MONTHS** by returning it to Dranetz Customer Service Department. If you decide to do so, first contact Dranetz to obtain an authorization number:

Telephone Number: (201) 287-3680
Telex Number: 499-7808
TWX Number: (710) 997-9553
FAX Number: (201) 248-9240
Cable: DRANETZ

Then fill out the REPAIR/SERVICE ORDER form enclosed in this manual and ship it along with the T&H Monitor to Dranetz Customer Service Department. (If this form is missing, request a replacement from Dranetz.)

CALIBRATING THE T&H MONITOR ON YOUR OWN

If you would like to calibrate the T&H Monitor on your own, contact Dranetz Customer Service Department for information on the necessary calibration equipment.

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656-XD-1002 CONDUCTED RF MONITOR

SCOPE

This portion of your manual contains the installation, programming, and operating instructions for the Dranetz Model 656-XD-1002 Conducted RF (Radio Frequency) Monitor. This section applies to you if you have purchased or intend to purchase the Conducted RF Monitor option. **THE CONDUCTED RF MONITOR DOES NOT REQUIRE RECALIBRATION.**

PURPOSE

Computers, peripherals, and other electronic equipment are highly sensitive to the quality of power delivered to their power supplies. Because radio frequency energy can alter the proper operation of such equipment, it is important to continuously monitor its operating environment for the presence of such energy.

APPLICATIONS

The Conducted RF Monitor lets you monitor conducted radio frequency energy that can alter the performance of electronic equipment. The Conducted RF Monitor measures conducted radio frequency energy (continuous and pulse) on a power line between line to neutral, line to ground, and neutral to ground. The 656 Sensor Channel Setups menu lets you select any sensitivity you desire.

If the initial storage memory of the 656 is empty, the 656 can store over 17,000 conducted RF events.

TRANSDUCER BOARD FACTORY PRESET VOLTAGE SETTING

The 656 Transducer Board is factory preset by an internal jumper to monitor voltage. This **MUST** be the setting to use the Conducted RF Monitor, and if you have changed the jumper setting to monitor current, change it back before proceeding (refer to Volume 2).

CONDUCTED RF MONITOR KIT CONTENTS

Verify that you have received the following contents with your Conducted RF Monitor Kit:

- Conducted RF Monitor with alligator clips and 9' cable attached
- 1' signal cable (P/N 113814-G1) with a connector end

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IF THE CONDUCTED RF MONITOR KIT IS DAMAGED

If any of the listed equipment is damaged, use the original packing case and materials to return the Conducted RF Monitor to Dranetz Customer Service Department. However, before returning any equipment, file an insurance claim with your underwriter or carrier or both, and then call Dranetz for a return authorization number:

Tel: (201) 287-3680
FAX: (201) 248-9240
TWX: (201) 997-9553
Telex: 499-7808
Cable: DRANETZ

After you receive an authorization number, fill out the REPAIR/SERVICE ORDER form in the back of this manual and ship it along with the Conducted RF Monitor to Dranetz Customer Service Department. (If this form is missing, request a replacement from Dranetz.)

TECHNICAL SPECIFICATIONS

TABLE 1002-1. CONDUCTED RF MONITOR SPECIFICATIONS

PHYSICAL	
Size	4" x 2" x 1.5" (102 x 51 x 38 mm)
Weight	5.5 ounces (156 grams)
Connections	9' shielded cable with alligator clips on 8" leads
OPERATING RANGES AND ACCURACY	
Storage	−5° to 55°C (23° to 131°F)
Operating	10° to 40°C (50° to 104°F)
Humidity	10% to 90% (non-condensing)
Measurement Range	0 to 50 Vpp RF
Frequency Range	100 kHz to 200 MHz
Frequency Response	1 to 100 MHz ±3dB; Typically −6 dB @ 100 kHz, 200 MHz
Linearity	±0.5 dB, 5 to 50 Vpp
INPUT/OUTPUT VOLTAGE	
Maximum Continuously Applied RF Voltage	120 Vpp
Maximum Continuously Applied Voltage	600 V RMS @ 60 Hz
Monitor's Output	0 to 10 V DC

CONNECTING THE MONITOR TO THE 656 TRANSDUCER BOARD

The 656 Sensor (Transducer) Board and strip must be installed in the 656 Mainframe in order to use the Conducted RF Monitor.

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WARNING

Verify that any monitored lines and the 656 are off before proceeding with connections. Because of possible shock or fire hazards, connection should be performed in compliance with the National Electric Code (ANSI C1) and any other applicable requirements. Installing, operating, and maintaining this unit should only be performed by qualified individuals. At the time of this writing, Underwriters Laboratories, Inc. has determined that a qualified person is self-determined by the individual attempting to perform the task.

1. Turn the 656 off, but leave it plugged in to maintain a safety ground.

2. Gently snap off the green 656 Sensor (Transducer) Channel strip from its board and connect the colored wires of the 1' cable to the strip as follows:

   - Brown wire to Terminal "3−"
   - Black wire to Terminal "3+"

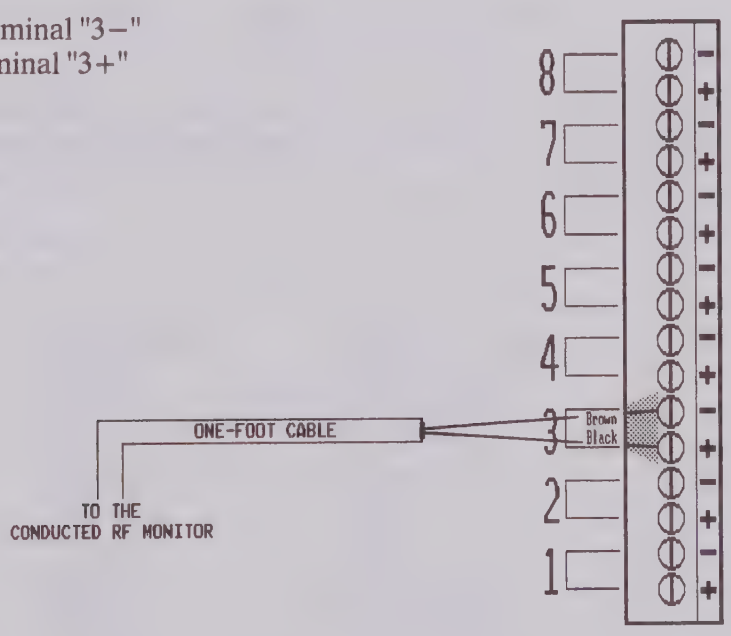

FIGURE 1002-1.

WIRING THE CONDUCTED RF MONITOR

3. Snap the Sensor (Transducer) channel strip with connected wires back on the board.

4. Plug the connector end of the 1' cable into the connector end of the 9' cable and twist it into place.

5. Place the Conducted RF Monitor on a flat surface.

6. Connect the colored alligator clips from the Conducted RF Monitor to the power line you are monitoring: black to "Hot", brown to "Neutral", and green to "Ground". This provides proper monitoring of line to neutral, line to ground, and neutral to ground.

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CONDUCTED RADIO FREQUENCY (RF) MONITORING

You have now connected conducted RF monitoring to Sensor channel S3 and you must program S3 to reflect this (refer to selection 2 under Subsection 2.8.4). Below is an example:

```
Sensor Channel Setups

1 Channel ..... 3
2 Status ..... On
3 Span Value ..... 50
4 Zero Value ..... 0
5 Units ..... Vpp RF
6 Sensitivity ..... 02.0%

(P)rint   e(X)it   (H)elp
```

Table 1002-2 indicates what percentage you should program under selection 6 to obtain the indicated sensitivity. Use the table for common sensitivities listed, however, use the formula following the table (top of next page) if you desire other degree sensitivities.

TABLE 1002-2. COMMON VPP RF SENSITIVITIES

For Sensitivity of:	Program Pctg:
0.5 Vpp RF	01.0%
1.0 Vpp RF†	**02.0%**
1.5 Vpp RF	03.0%
2.0 Vpp RF	04.0%
2.5 Vpp RF	05.0%
3.0 Vpp RF	06.0%
3.5 Vpp RF	07.0%
4.0 Vpp RF	08.0%
4.5 Vpp RF	09.0%
5.0 Vpp RF	10.0%
5.5 Vpp RF	11.0%
6.0 Vpp RF	12.0%
6.5 Vpp RF	13.0%
7.0 Vpp RF	14.0%
7.5 Vpp RF	15.0%
8.0 Vpp RF	16.0%
8.5 Vpp RF	17.0%
9.0 Vpp RF	18.0%
9.5 Vpp RF	19.0%
10 Vpp RF	20.0%

†Factory preset value.

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The formula used to derive the percentage values in the previous chart is:

Event Sensitivity = Sensitivity x (Span Value − Zero Value)

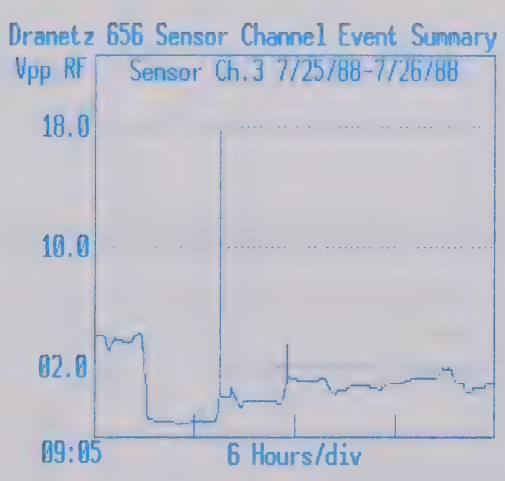
For Example:
1.0 Vpp RF Sensitivity = 02.0% x (50 − 0)
1.5 Vpp RF Sensitivity = 03.0% x (50 − 0)
4.0 Vpp RF Sensitivity = 08.0% x (50 − 0)

Once Sensor channel S3 has been set up, you are nearly ready to begin conducted RF monitoring. As one final check, make sure the "Status" line of Sensor channel screen "3" reads "On" (refer to selection 2 in Subsection 2.8.4). Once the status for the setup is "On", turn the 656 off and then on again. This resets the unit, and when it comes on it captures an initial event for each Main and Sensor channel with status "On".

PLOTTING GRAPHIC SUMMARIES OF CONDUCTED RF EVENTS

From the 656 Main Menu you can plot a graphic summary of recorded conducted RF events. To do so, press <*1*> while in the Main Menu and then press <*3*> to plot a Sensor channel summary. Use selection 1 to choose Sensor channel S3. Then select the time span of the desired plot.

Below is an example Sensor channel plot of S3. This 24-hour plot was recorded from 9:05 a.m. on July 25, 1988 through 9:05 a.m. on July 26, 1988:



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VIEWING CONDUCTED RADIO FREQUENCY (RF) EVENTS

You can view the text of recorded conducted RF events by their order of occurrence or by their time and date of occurrence. To do so, press <*2*> while in the Main Menu and then press <*1*> to view events by number (of occurrence) or press <*2*> to view events by time and date (of occurrence). Some example conducted RF events are listed below (assume a sensitivity of 1.0 Vpp RF):

Event #19 7/25/88 09:05:33:06

Sensor Channel S3 initial event
Value when setup activated = 3.25 Vpp RF

Event #21 7/25/88 09:08:46.21

Sensor Channel S3 value changed
from 3.25 to 4.25 Vpp RF

Event #24 7/25/88 09:10:14.45

Sensor Channel S3 value changed
from 4.25 to 5.29 Vpp RF

Event #25 7/25/88 09:11:56:13

Sensor Channel S3 value changed
from 5.29 to 4.24 Vpp RF

RETURNING THE CONDUCTED RF MONITOR FOR FACTORY REPAIR

The Conducted RF Monitor **IS NOT USER SERVICEABLE**, therefore, you must return it to the factory for any repairs. Before doing so, contact Dranetz Customer Service Department to obtain an authorization number:

Telephone Number: (201) 287-3680
Telex Number: 499-7808
TWX Number: (710) 997-9553
FAX Number: (201) 248-9240
Cable: DRANETZ

Then fill out the REPAIR/SERVICE ORDER form enclosed in this manual and ship it along with the Conducted RF Monitor to Dranetz Customer Service Department. (If this form is missing, request a replacement from Dranetz.)

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656-XD-1003 RADIATED RF MONITOR

SCOPE

This portion of your manual contains the installation, programming, and operating instructions for the Dranetz Model 656-XD-1003 Radiated RF (Radio Frequency) Monitor. It applies to you if you have purchased or intend to purchase the Radiated RF Monitor option. **THE RADIATED RF MONITOR DOES NOT REQUIRE RECALIBRATION.**

PURPOSE

Computer-based electronic equipment is highly susceptible to environmental RF energy. Significant RF field strengths are commonly produced by walkie-talkies, radio or television broadcasts, faulty automobile ignitions, and so forth. RF energy can couple into electronic equipment through its enclosure and power line because the enclosure and power line act as antennas that draw the RF energy inside the equipment. Once inside, RF energy can alter the equipment's operation, therefore, it is important to continuously monitor it operating environment for the presence of RF energy.

APPLICATIONS

The Radiated RF Monitor lets you monitor disruptive radiated RF energy in the operating environment of your electronic equipment. The Radiated RF Monitor is a broadband, omnidirectional antenna that measures the radiated electric field strength of short and long duration RF energy in the general area where it is placed. The 656 Sensor Channel Setups menu lets you select any sensitivity you desire.

If the initial storage memory of the 656 is empty, the 656 can store over 17,000 radiated RF events.

TRANSDUCER BOARD FACTORY PRESET VOLTAGE SETTING

The 656 Transducer Board is factory preset by an internal jumper to monitor voltage. This MUST be the setting to use the Radiated RF Monitor, and if you have changed the jumper setting to monitor current, change it back before proceeding (refer to Volume 2).

RADIATED RF MONITOR KIT CONTENTS

Verify that you have received the following contents with your Radiated RF Monitor Kit:

- Radiated RF Monitor with alligator clips and 9' cable attached
- 1' signal cable (P/N 113814-G1) with a connector end

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IF THE RADIATED RF MONITOR KIT IS DAMAGED

If any of the listed equipment is damaged, use the original packing case and materials to return the Radiated RF Monitor to Dranetz Customer Service Department. However, before returning any equipment, file an insurance claim with your underwriter or carrier or both, and then call Dranetz Customer Service Department for a return authorization number:

Tel: (201) 287-3680
FAX: (201) 248-9240
TWX: (201) 997-9553
Telex: 499-7808
Cable: DRANETZ

After you receive an authorization number, fill out the REPAIR/SERVICE ORDER form in the back of this manual and ship it along with the Radiated RF Monitor to Dranetz Customer Service Department. (If this form is missing, request a replacement from Dranetz.)

BATTERY TEST

The Radiated RF Monitor is shipped with a long life 9V alkaline battery. Before operating the Radiated RF Monitor, you should check the condition of its battery by pressing the BATTERY TEST button. If the green Battery "OK" LED lights, the battery checks out. If the LED does not light, the battery should be replaced.

To Replace the Battery:

Remove the four screws securing the bottom plastic cover to the Monitor. Remove the battery from its holder and replace it with a new 9V alkaline battery. (**Do not use a NiCad battery.**) Push the BATTERY TEST button to verify that the LED lights. If it does, replace the cover and reinsert the screws; if it still doesn't light, verify that the battery is live, and if so, return the unit for service. The recommended batteries for 1 year life are:

DURACELL MN1604
EVEREADY 522
RAY-O-VAC A1604

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TECHNICAL SPECIFICATIONS

TABLE 1003-1. RADIATED RF MONITOR SPECIFICATIONS

PHYSICAL	
Size	6" x 6" x 4.5" (153 x 153 x 115 mm)
Weight	24 ounces (680 grams)
Connections	9' shielded cable
OPERATING RANGES AND ACCURACY	
Storage	−5° to 55°C (23° to 131°F)
Operating	10° to 40°C (50° to 104°F)
Humidity	10% to 90% (non-condensing)
Measurement Range	0 to 30 Volts/meter (V/m)
Frequency Range	50 kHz to 250 MHz
Frequency Response	100 kHz to 100 MHz ±3dB; 50 kHz to 250 MHz ±6dB
Linearity	±10% of reading ±0.02 V/m/°C; 1 to 30 V/m referenced to 10 MHz @ 20°C
POWER/OUTPUT	
Power	9V alkaline battery
Battery Life	1 year (approx.)
Battery Test	Momentary push button: Green LED lights for battery "OK" indication
Output	0 to 5 V DC

CONNECTING THE MONITOR TO THE 656 TRANSDUCER BOARD

The 656 Sensor (Transducer) Board and strip must be installed in the 656 Mainframe in order to use the Radiated RF Monitor.

WARNING

Verify that any monitored lines and the 656 are off before proceeding with any connections. Because of possible shock or fire hazards, connection should be performed in compliance with the National Electric Code (ANSI C1) and any other applicable requirements. Installing, operating, and maintaining the equipment should only be performed by qualified individuals. At the time of this writing, Underwriters Laboratories, Inc. has determined that a qualified person is self-determined by the individual attempting to perform the task.

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1. Turn the 656 off, but leave it plugged in to maintain a safety ground.

2. Gently snap off the green 656 Sensor (Transducer) Channel strip from its board and connect the colored wires of the 1' cable to the strip as follows:

   - Brown wire to Terminal "4−"
   - Black wire to Terminal "4+"

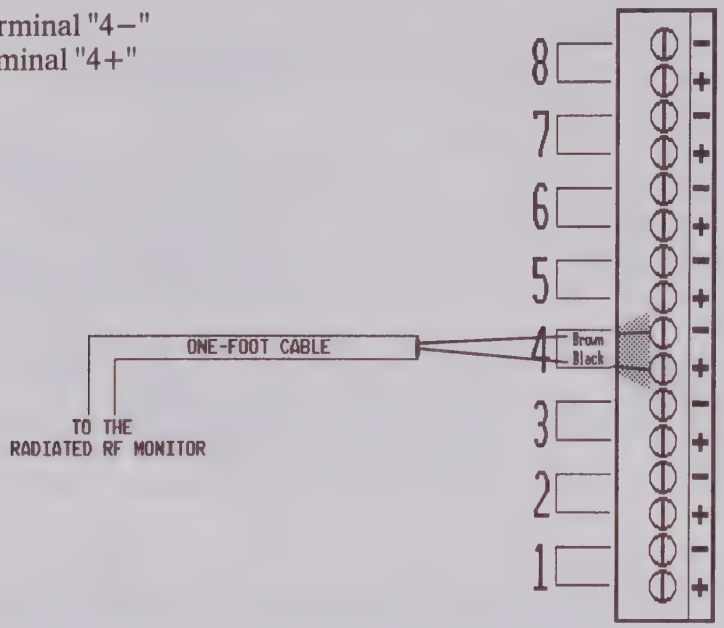

FIGURE 1003-1.

WIRING THE RADIATED RF MONITOR

3. Snap the Sensor (Transducer) channel strip with connected wires back on the board.

4. Plug the connector end of the 1' cable into the connector end of the 9' cable and twist it into place.

5. Place the Radiated RF Monitor on a flat surface (a horizontal conductive surface if possible).

RADIATED RADIO FREQUENCY (RF) MONITORING

You have now connected radiated RF monitoring to Sensor channel S4. You must now program S4 to reflect this (refer to selection 2 under Subsection 2.8.4). Below is an example:

```
Sensor Channel Setups

1 Channel ..... 4
2 Status ..... On
3 Span Value ..... 60
4 Zero Value ..... 0
5 Units ..... V/m
6 Sensitivity ..... 1.7%

(P)rint   e(X)it   (H)elp
```

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Table 1003-2 indicates what percentage you should program under selection 6 to obtain the indicated sensitivity. Use the table for common sensitivities listed, however, use the formula following the table if you desire other degree sensitivities.

TABLE 1003-2. COMMON V/M SENSITIVITIES

For Sensitivity of:	Program Pctg:
0.5 V/m	00.8%
1.0 V/m†	**01.7%**
1.5 V/m	02.5%
2.0 V/m	03.3%
2.5 V/m	04.2%
3.0 V/m	05.0%
3.5 V/m	05.8%
4.0 V/m	06.7%
4.5 V/m	07.5%
5.0 V/m	08.3%
5.5 V/m	09.2%
6.0 V/m	10.0%
6.5 V/m	10.8%
7.0 V/m	11.7%
7.5 V/m	12.5%
8.0 V/m	13.3%
8.5 V/m	14.2%
9.0 V/m	15.0%
9.5 V/m	15.8%
10 V/m	16.7%

The formula used to derive the percentage values in the previous chart is:

Event Sensitivity = Sensitivity x (Span Value − Zero Value)

For Example:
1.0 V/m Sensitivity = 01.7% x (60 − 0)
1.5 V/m Sensitivity = 02.5% x (60 − 0)
6.0 V/m Sensitivity = 10.0% x (60 − 0)

Once Sensor channel S4 has been set up, you are nearly ready to radiated RF monitoring. As one final check, make sure the "Status" line of Sensor channel screen "4" reads "On" (refer to selection 2 in Subsection 2.8.4). Once the status for the setup is "On", turn the 656 off and then on again. This resets the unit, and when it comes on it captures an initial event for each Main and Sensor channel with status "On".

†Factory preset value.

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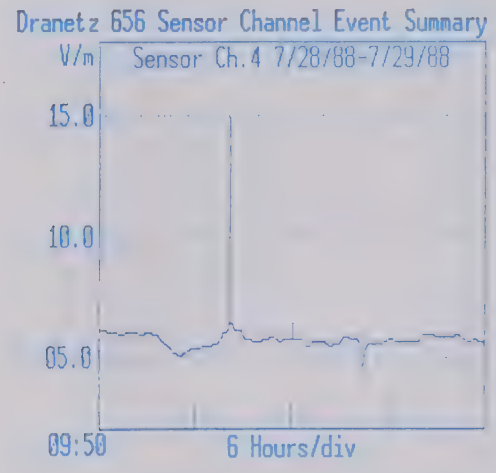
PLOTTING GRAPHIC SUMMARIES OF RADIATED RF EVENTS

From the 656 Main Menu you can plot a graphic summary of recorded radiated RF events. To do so, press <*1*> while in the Main Menu and then press <*3*> to plot a Sensor channel summary. Use selection 1 to choose Sensor channel S4. Then select the time span of the desired plot.

Below is an example Sensor channel plot of S4. This 24-hour plot was recorded from 9:50 a.m. on July 28, 1988 through 9:50 a.m. on July 29, 1988:



VIEWING RADIATED RADIO FREQUENCY (RF) EVENTS

You can view the text of recorded radiated RF events by their order of occurrence or by their time and date of occurrence. To do so, press <*2*> while in the Main Menu and then press <*1*> to view events by number (of occurrence) or press <*2*> to view events by time and date (of occurrence). Some example radiated RF events are listed below (assume a sensitivity of 1.0 Vpp RF):

Event #12 7/28/88 09:50:21:09

Sensor Channel S4 initial event
Value when setup activated = 6.05 V/m

Event #13 7/28/88 09:53:39.12

Sensor Channel S4 value changed
from 6.05 to 7.05 V/m

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Event #17 7/28/88 09:58:44.10

Sensor Channel S4 value changed
from 7.05 to 8.08 V/m

Event #19 7/28/88 09:59:12:42

Sensor Channel S4 value changed
from 8.08 to 7.03 V/m

RETURNING THE RADIATED RF MONITOR FOR FACTORY REPAIR

Other than periodical 9V battery replacement, the Radiated RF Monitor **IS NOT USER SERVICEABLE**, therefore, you must return it to the factory for any repairs. Before doing so, contact Dranetz Customer Service Department to obtain an authorization number:

Telephone Number: (201) 287-3680
Telex Number: 499-7808
TWX Number: (710) 997-9553
FAX Number: (201) 248-9240
Cable: DRANETZ

Then fill out the REPAIR/SERVICE ORDER form enclosed in this manual and ship it along with the Radiated RF Monitor to Dranetz Customer Service Department. (If this form is missing, request a replacement from Dranetz.)

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APPENDIX A
SERIES 656/656A HARDWARE AND SOFTWARE ERROR MESSAGES

A.1 GENERAL

This appendix contains a listing of the possible hardware/software error messages that can appear on screen during operation. Following each error message is the appropriate action you should take.

A.2 ERROR MESSAGES

1. This version of disk software will not work with the current version of ROMs installed. To upgrade the ROMs, please call Dranetz Customer Service Dept. at (USA) 201-287-3680

2. A System exception has occurred on the CRT board.

   The unit cannot function until it is repaired. Please call Dranetz Customer Service Dept. at (USA) 201-287-3680

3. A System exception has occurred on the Floppy Disk board.

   The unit cannot function until it is repaired. Please call Dranetz Customer Service Dept. at (USA) 201-287-3680

4. A System exception has occurred on the FPIB board.

   The unit cannot function until it is repaired. Please call Dranetz Customer Service Dept. at (USA) 201-287-3680

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5. A System exception has occurred on the Printer board.

   The unit cannot function until it is repaired. Please call Dranetz Customer Service Dept. at (USA) 201-287-3680

6. A System exception has occurred on the FEP board.

   The unit cannot function until it is repaired. Please call Dranetz Customer Service Dept. at (USA) 201-287-3680

7. A System exception has occurred in Event Memory.

   The unit cannot function until it is repaired. Please call Dranetz Customer Service Dept. at (USA) 201-287-3680

8. A System exception has occurred on the FEP board.

   (An applicable message is listed here)

9. A System exception has occurred on the CPU board.

   Turning the unit off and on may correct the problem. If this message appears again, the unit must be repaired. If so, please call Dranetz Customer Service Dept. at (USA) 201-287-3680

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10. There is a software mismatch in the CPU software.

    Turning the unit off and on may correct the problem. If this message appears again, the unit must be repaired. If so, please call Dranetz Customer Service Dept. at (USA) 201-287-3680

11. There is a software mismatch in the FEP software.

    Turning the unit off and on may correct the problem. If this message appears again, the unit must be repaired. If so, please call Dranetz Customer Service Dept. at (USA) 201-287-3680

12. There is a software mismatch in the FEP software.

    The unit cannot function until it is repaired. Please call Dranetz Customer Service Dept. (USA) 201-287-3680

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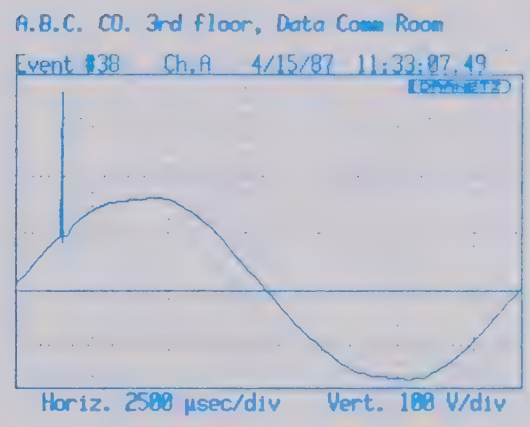
APPENDIX B
EXAMPLE WAVEFORM DISTURBANCES

B.1 EXAMPLES

This appendix contains various example waveform disturbances and their associated text displays.

Below is an example single cycle Line A-to-Neutral impulse disturbance with an amplitude of +256 Vpk:




```
Event #38, Channel A Setup #02
Wed. Apr 15, 1987  11:33:07.49
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=117.0 Vmin=116.3 Vmax=116.3
High Frequency Hits: 1
   Worst HF Event:
   Amplitude +256 Vpk
   Position  33 degrees
```

Below is an example multicycle Line A-to-Neutral sequence of impulse disturbances with worst case amplitude of -290 Vpk:

```
Event #50, Channel A Setup #02
Thu. Apr 16, 1987  16:10:40.77
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.1 Hz
RMS Voltages Measured:
Prev. Event=114.5 Vmin=115.1 Vmax=123.1
High Frequency Hits: 3
   Worst HF Event:
   Amplitude -290 Vpk
   Position  335 degrees
```

In the above displays, "High Frequency Hits" are the number of separate high frequency occurrences in the event. "Position" indicates the sine wave phase position of the worst case high frequency event.

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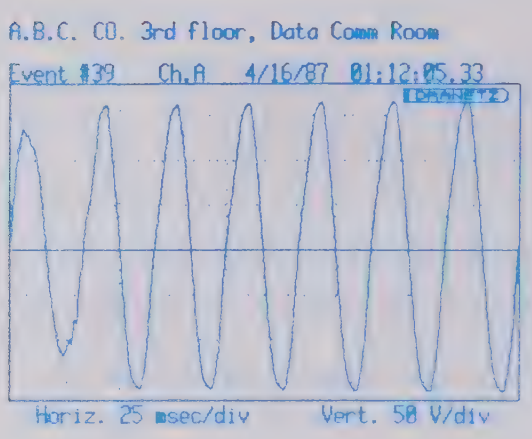
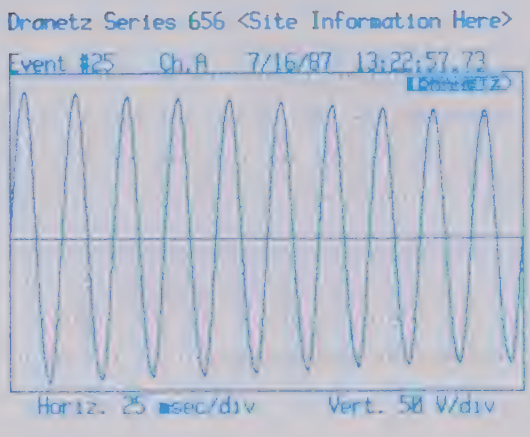
Below is an example single cycle Line A-to-Neutral sag disturbance that reached a minimum of 92.7 V. The beginning of the waveform is the sag and the rest is the waveform after it has returned to within limits:



Event #39, Channel A Setup #02
Thu. Apr 16, 1987 01:12:05.33
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=116.3 Vmin=92.7 Vmax=117.5
High Frequency Hits: 0

Below is an example multicycle Line A-to-Neutral sine disturbance that reached a maximum of 130.0 V. The beginning of the waveform is the surge and the rest is the waveform returning to normal state:



Event #25, Channel A Setup #01
Thu. Jul 16, 1987 13:22:57.73
Dranetz Series 656 <Site Information Here>

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=134.7 Vmin=112.5 Vmax=130.0
High Frequency Hits: 0

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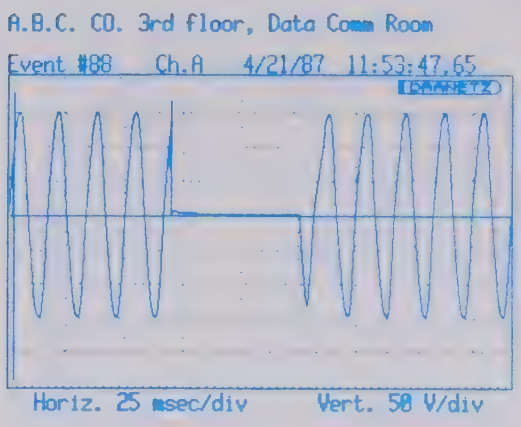
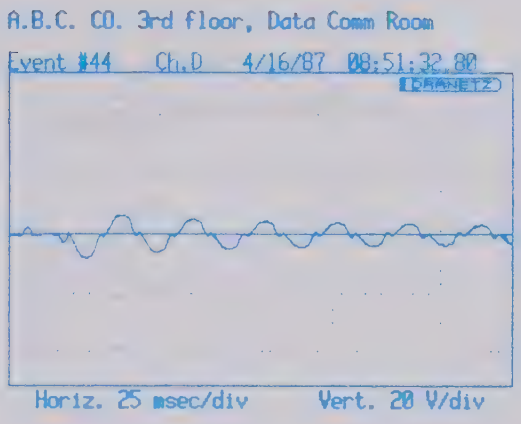
Below is an example multicycle Line A-to-Neutral voltage dropout:



Event #88, Channel A Setup #02
Tue. Apr 21, 1987 11:53:47.65
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=106.7 Vmin=2.5 Vmax=107.4
High Frequency Hits: 2
Worst HF Event:
Amplitude -329 Vpk
Position 42 degrees

Below is an example multicycle Neutral-to-Ground RMS disturbance:



Event #44, Channel D Setup #02
Thu. Apr 16, 1987 08:51:32.80
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=1.3 Vmin=2.2 Vmax=3.3
High Frequency Hits: 0

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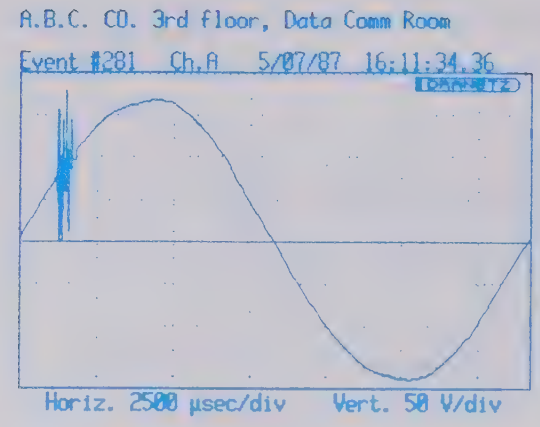
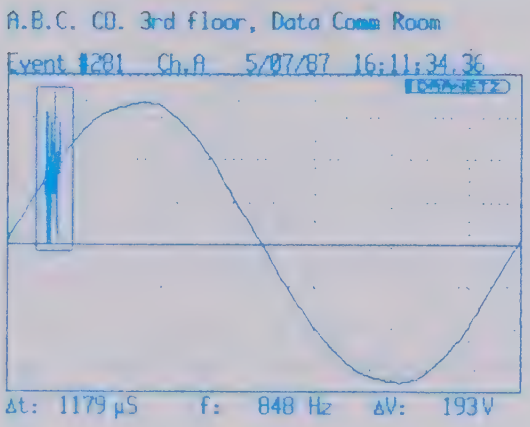
Below is an example
Line A-to-Neutral RF "burst"
disturbance:



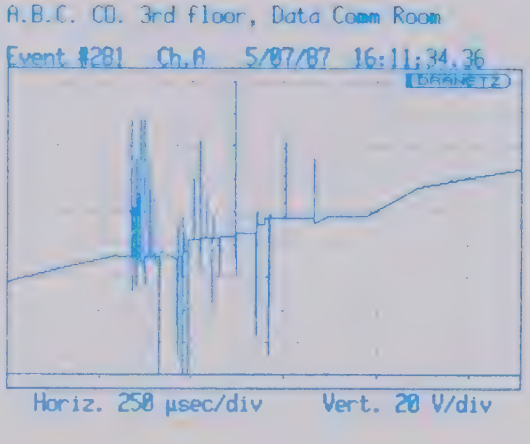
Below is the disturbance on the
left after the zoom box has been
brought up and positioned:



Event #281, Channel A Setup #02
Thu. May 7, 1987 16:11:34.36
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=118.5 Vmin=117.8 Vmax=117.8
High Frequency Hits: 1
Worst HF Event:
Amplitude +94 Vpk
Position 26 degrees

Below is the same disturbance
after it has been zoomed:



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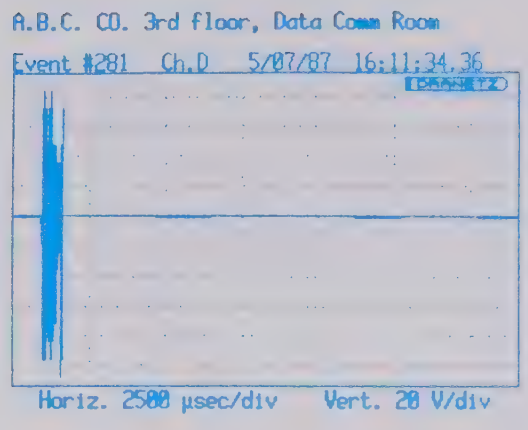
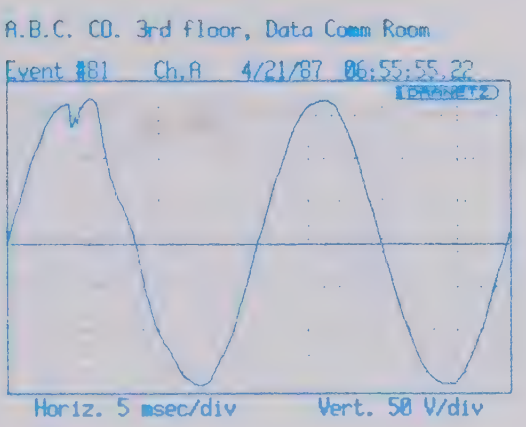
Below is an example Neutral-to-Ground RF "burst" disturbance:



Event #281, Channel D Setup #02
Thu. May 7, 1987 16:11:34.36
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=0.7 Vmin=0.3 Vmax=0.3
High Frequency Hits: 1
Worst HF Event:
Amplitude -100 Vpk
Position 21 degrees

Below is an example Line A-to-Neutral waveform disturbance caused by a load being turned on in the building:



Event #81, Channel A Setup #02
Tue. Apr 21, 1987 06:55:55.22
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=119.6 Vmin=118.1 Vmax=118.7
High Frequency Hits: 0

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APPENDIX C
MAIN & SENSOR (TRANSDUCER) CHANNEL SETUP SCREENS

C.1 GENERAL

This appendix contains the 16 possible Main Channel Setup screens and four Sensor (Transducer) Channel Setup screens. The setup number corresponding to each screen is displayed in the upper left corner.

The SETUP knob determines which Main channel setup is the default when the 656 is first turned on. Afterwards, the setups are changed using selection 1 in the Monitoring Functions Menu.

```
1 Setup #01 A      B      C      D
2 Range     VH     Off    Off    VL
```

(120V - Single Phase + N/G)

```
6 Imp.      0100 010.0 010.0 025.0
7 Wave       007  00.7  00.7  05.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #02 A      B      C      D
2 Range     VH     Off    Off    Off
```

(120V - Single Phase)

```
6 Imp.      0100 010.0 010.0 025.0
7 Wave       007  00.7  00.7  05.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

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```
1 Setup #03 A      B      C      D
2 Range     VH     Off    Off    VL
```

(208V - Single Phase + N/G)

```
6 Imp.      0200 020.0 020.0 025.0
7 Wave       015  01.5  01.5  05.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #04 A      B      C      D
2 Range     VH     VH     VH     VL
```

(208V - Three Phase + N/G)

```
6 Imp.      0200  0200  0200 025.0
7 Wave       015   015   015  05.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #05 A      B      C      D
2 Range     VH     Off    Off    VL
```

(220V - Single Phase + N/G)

```
6 Imp.      0200 020.0 020.0 025.0
7 Wave       015  01.5  01.5  05.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

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```
1 Setup #06 A      B      C      D
2 Range     VH     Off    Off    Off
```

(220V - Single Phase)

```
6 Imp.     0200 020.0 020.0 025.0
7 Wave      015  01.5  01.5  05.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #07 A      B      C      D
2 Range     VH     VH     VH     Off
```

(240V - Split Phase [2 x 120V])

```
6 Imp.     0200  0100  0100 025.0
7 Wave      015   007   007  05.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #08 A      B      C      D
2 Range     VH     VH     VH     VL
```

(277V - Three Phase + N/G)

```
6 Imp.     0200  0200  0200 025.0
7 Wave      020   020   020  05.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

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```
1 Setup #09 A      B      C      D
2 Range     VH     VH     VH     Off
```

(277V - Three Phase)

```
6 Imp.     0200   0200   0200 025.0
7 Wave      020    020    020  05.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #10 A      B      C      D
2 Range     VH     VH     VH     VL
```

(380V - Three Phase + N/G)

```
6 Imp.     0200   0200   0200 100.0
7 Wave      025    025    025  10.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #11 A      B      C      D
2 Range     VH     VH     VH     VL
```

(480V - Three Phase + N/G)

```
6 Imp.     0300   0300   0300 100.0
7 Wave      030    030    030  10.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

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```
1 Setup #12 A      B      C      D
2 Range     VH     VH     VH     VL

6 Imp.      0300   0300   0300 100.0
7 Wave       030    030    030  10.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

(480V - Three Phase Delta)

```
1 Setup #13 A      B      C      D
2 Range     VH     VL     VL     VL

6 Imp.      0100 025.0 025.0 025.0
7 Wave       007  00.7  00.7  00.7
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

(120V + 3 DC Channels)

```
1 Setup #14 A      B      C      D
2 Range     VH     VL     Off    VL

6 Imp.      0100 025.0 010.0 025.0
7 Wave       007  00.2  00.7  05.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

(120V + 5 VDC + N/G)

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```
1 Setup #15 A      B      C      D
2 Range     VH     Off    Off    Off
```

(Sensitive Impulse Mode)

```
6 Imp.      0024 002.4 002.4 002.4
7 Wave       580  58.0  58.0  58.0
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

```
1 Setup #16 A      B      C      D
2 Range     VH     Off    Off    Off
```

(Sensitive Voltage Mode)

```
6 Imp.      6120 612.0 612.0 612.0
7 Wave       002  00.2  00.2  00.2
8 Frequency    0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

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```
      Sensor Channel Setups
1 Channel ..... 1
2 Status ..... Off
3 Span Value ..... +00055
4 Zero Value ..... -00005
5 Units ..... Deg. C
6 Sensitivity ..... 02.0%

(P)rint        e(X)it        (H)elp
```

```
      Sensor Channel Setups
1 Channel ..... 2
2 Status ..... Off
3 Span Value ..... +00100
4 Zero Value ..... +00000
5 Units ..... % RH
6 Sensitivity ..... 02.0%

(P)rint        e(X)it        (H)elp
```

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```
     Sensor Channel Setups
1 Channel ......... 3
2 Status .......... Off
3 Span Value ...... +00050
4 Zero Value ...... +00000
5 Units ........... Vpp RF
6 Sensitivity ..... 02.0%

(P)rint        e(X)it        (H)elp
```

```
     Sensor Channel Setups
1 Channel ......... 4
2 Status .......... Off
3 Span Value ...... +00060
4 Zero Value ...... +00000
5 Units ........... V/m
6 Sensitivity ..... 01.7%

(P)rint        e(X)it        (H)elp
```

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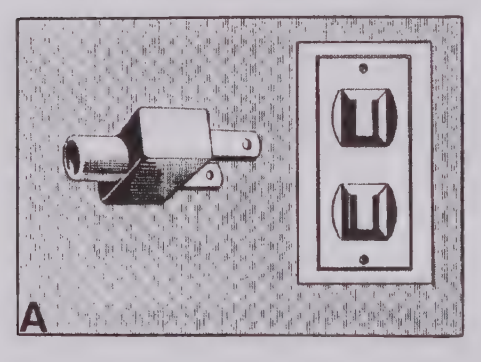
APPENDIX D
RECOMMENDED MAIN CHANNEL SETUPS BY COUNTRY

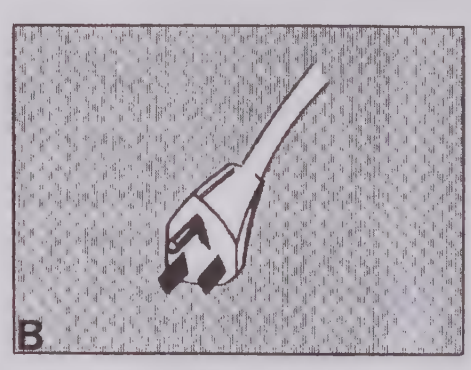
D.1 TYPES OF ELECTRICAL PLUGS IN USE

This section contains an illustration and a brief description of the types of electrical plugs in use. Section D.2 describes which of these plugs are used in countries outside of the U.S.



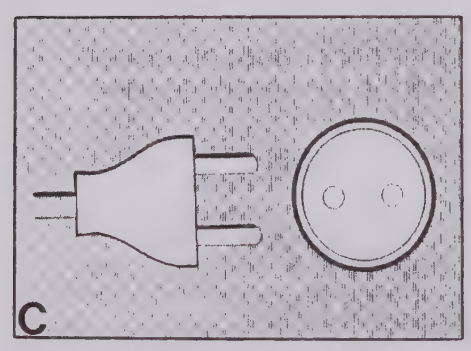
Type A

Flat Blade Attachment Plug



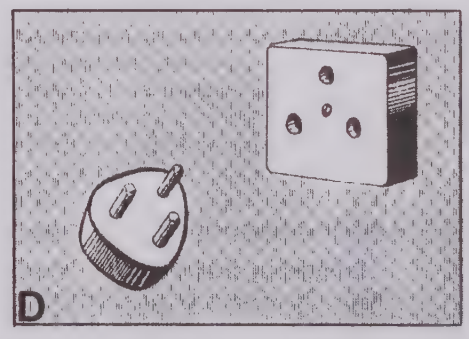
Type B

Flat Blades with Round Grounding Pin



Type C

Round Pin Attachment Plug



Type D

Round Pins with Ground

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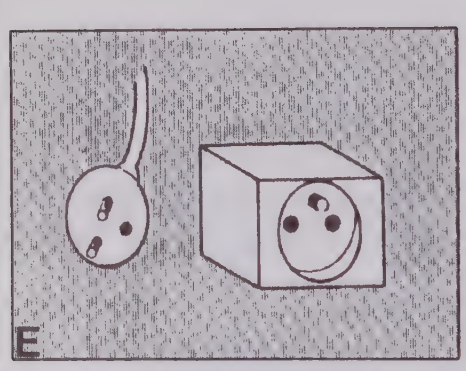
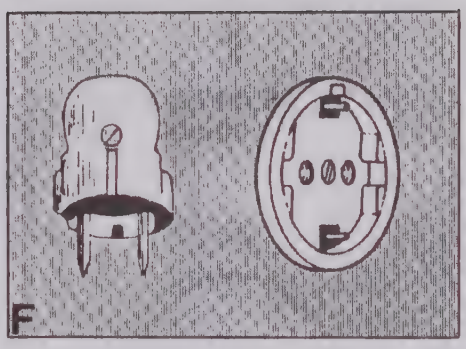


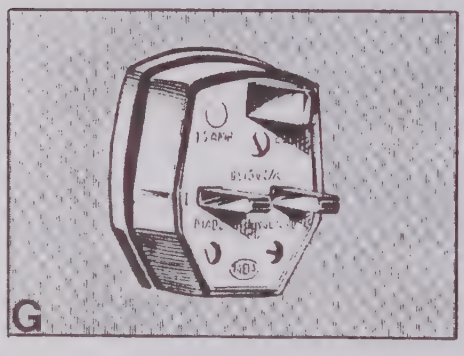
Type E

Round Pin Plug and Receptacle with Male Grounding Pin



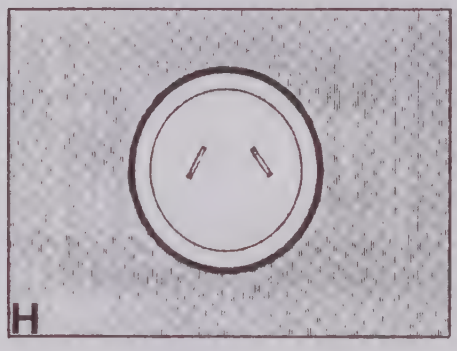
Type F

"Schuko" Plug and Receptacle with Side Grounding Contacts



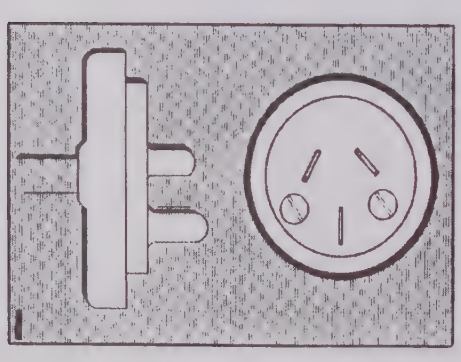
Type G

Rectangular Blade Plug



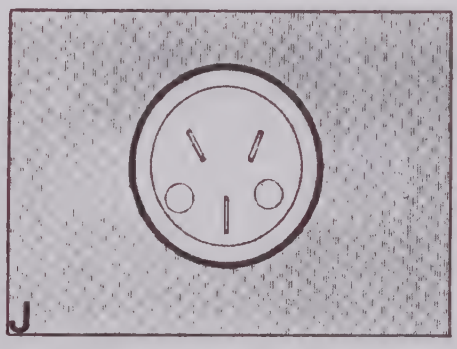
Type H

Oblique Flat Blades



Type I

Oblique Flat Blades with Ground



Type J

Oblique Flat Blades with Ground

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D.2 ELECTRICAL PLUGS AND RECOMMENDED MAIN CHANNEL SETUPS OUTSIDE OF THE UNITED STATES

Below is an alphabetical list of countries with their respective nominal power voltages, electrical plugs used, and recommended Main Channel Setups programmed into the 656.

Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Afghanistan	220 Vrms 380 Vrms	D	5 or 6 10	50/60 Hz
Algeria	127 Vrms 220 Vrms 380 Vrms	C,D	1, 2, 13, or 14 5 or 6 10	50 Hz
Angola	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
Antigua	230 Vrms 400 Vrms	A,B,G	7 10	50 Hz
Argentina	220 Vrms 380 Vrms 390 Vrms	C,G	5 or 6 10 10	50 Hz
Australia	240 Vrms 415 Vrms 440 Vrms	I	7 10 11 or 12	50 Hz
Austria	220 Vrms 380 Vrms	F	5 or 6 10	50 Hz
Azores	220 Vrms 380 Vrms	C,D	5 or 6 10	50 Hz
Bahamas	120 Vrms 208 Vrms 240 Vrms 415 Vrms	A,B	1, 2, 13, or 14 3 or 4 7 10	60 Hz
Bahrain	110 Vrms 220 Vrms 380 Vrms 400 Vrms	D,G	1, 2, 13, or 14 5 or 6 10 10	50/60 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Bangladesh	230 Vrms 400 Vrms	C,D	5 or 6 10	50 Hz
Barbados	115 Vrms	A,B	1, 2, 13, or 14	50 Hz
Belgium	220 Vrms 240 Vrms 380 Vrms 400 Vrms 415 Vrms	C,E	5 or 6 7 10 10 10	50 Hz
Bermuda	120 Vrms 208 Vrms	A,B,G,I	1, 2, 13, or 14 3 or 4	60 Hz
Bolivia	110 Vrms	A,B,C,F	1, 2, 13, or 14	50/60 Hz
Botswana	220 Vrms	D,G	5 or 6	50 Hz
Brazil	110 Vrms 127 Vrms 220 Vrms	A,B,C,D,E,F,G,H,I,J	1, 2, 13, or 14 1, 2, 13, or 14 5 or 6	50/60 Hz
Bulgaria	220 Vrms	C,F	5 or 6	50 Hz
Burma	220 Vrms	D,G	5 or 6	50 Hz
Burundi	220 Vrms	C,E,F	5 or 6	50 Hz
Cambodia	120 Vrms 220 Vrms	(No Info)	1, 2, 13, or 14 5 or 6	50 Hz
Cameroon	127 Vrms 220 Vrms	C,E	1, 2, 13, or 14 5 or 6	50 Hz
Canada	120 Vrms 208 Vrms 240 Vrms 347 Vrms 480 Vrms 600 Vrms	C,E	1, 2, 13, or 14 4 7 10 11 or 12 11 or 12	60 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Canary Islands	127 Vrms 220 Vrms	C,E	1, 2, 13, or 14 5 or 6	50 Hz
Cayman Islands	120 Vrms 208 Vrms 227 Vrms 240 Vrms 480 Vrms	A,B	1, 2, 13, or 14 4 5 or 6 7 11 or 12	not avail.
Central African Republic	220 Vrms	C	5 or 6	50 Hz
Chad	220 Vrms 380 Vrms	D,E,F	5 or 6 10	50 Hz
Chile	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
China	220 Vrms 380 Vrms	C,J	5 or 6 10	50 Hz
Columbia	120 Vrms 240 Vrms	A,C	1, 2, 13, or 14 7	60 Hz
Congo	220 Vrms		5 or 6	50 Hz
Costa Rica	120 Vrms 240 Vrms	A,D,I,J	1, 2, 13, or 14 7	60 Hz
Cyprus	115 Vrms 240 Vrms	G	1, 2, 13, or 14 7	50 Hz
Czechoslovakia	220 Vrms 380 Vrms	E	5 or 6 10	50 Hz
Denmark	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
Dominican Rep.	110 Vrms 220 Vrms	A,J	1, 2, 13, or 14 5 or 6	60 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Ecuador	110 Vrms 120 Vrms 208 Vrms 220 Vrms 240 Vrms	A,C	1, 2, 13, or 14 1, 2, 13, or 14 3 or 4 5 or 6 7	60 Hz
Egypt	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
El Salvador	120 Vrms 240 Vrms	A,B,G,I,J	1, 2, 13, or 14 7	60 Hz
Ethiopia	220 Vrms 380 Vrms	C,D,F	5 or 6 10	50 Hz
Fiji Islands	240 Vrms 415 Vrms	I	7 10	50 Hz
Finland	220 Vrms 380 Vrms 660 Vrms	C,F	5 or 6 10 12	50 Hz
France	127 Vrms 220 Vrms 380 Vrms	C,E,F,G	1, 2, 13, or 14 5 or 6 10	50 Hz
French Guiana	220 Vrms	C,D,E	5 or 6	50 Hz
Gabon	220 Vrms	C,E	5 or 6	50 Hz
Gambia	230 Vrms 400 Vrms	G	7 10	50 Hz
Germany (Fed. Rep.)	220 Vrms 380 Vrms	F	5 or 6 10	50 Hz
Germany (Dem. Rep.)	127 Vrms 220 Vrms 380 Vrms 660 Vrms	C,F	1, 2, 13, or 14 5 or 6 10 12	not avail.
Ghana	250 Vrms 440 Vrms	C,D,G	5 or 6 11 or 12	50 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Gibraltar	240 Vrms 415 Vrms	C,G	7 10	50 Hz
Great Britain (See United Kingdom)				
Greece	220 Vrms 380 Vrms	C,D,F	5 or 6 10	50 Hz
Greenland	220 Vrms	C	5 or 6	50 Hz
Grenada	230 Vrms 400 Vrms	C,D,G	7 10	50 Hz
Guadeloupe	220 Vrms 380 Vrms	C,D,E	5 or 6 10	50 Hz
Guam	120 Vrms 208 Vrms 227 Vrms 240 Vrms 480 Vrms	A,B	1, 2, 13, or 14 3 or 4 5 or 6 7 11 or 12	not avail.
Guatemala	120 Vrms 240 Vrms	A,B	1, 2, 13, or 14 7	60 Hz
Guyana	110 Vrms 240 Vrms	A,B,C,D,G	1, 2, 13, or 14 7	50/60 Hz
Haiti	115 Vrms 220 Vrms 380 Vrms	A,B,I,J	1, 2, 13, or 14 5 or 6 10	60 Hz
Honduras	110 Vrms 220 Vrms	A,B	1, 2, 13, or 14 5 or 6	60 Hz
Hong Kong	200 Vrms 220 Vrms 346 Vrms 380 Vrms	D	5 or 6 5 or 6 10 10	50 Hz
Hungary	220 Vrms 380 Vrms	F	5 or 6 10	50 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Iceland	220 Vrms 380 Vrms	C,F	5 or 6 10	50 Hz
India	230 Vrms 250 Vrms 400 Vrms 440 Vrms	C,D	7 7 10 11 or 12	50 Hz
Indonesia	127 Vrms 220 Vrms 380 Vrms	C,E,F	1, 2, 13, or 14 5 or 6 10	50 Hz
Iraq	220 Vrms 380 Vrms	C,D,G	5 or 6 10	50 Hz
Ireland	220 Vrms 230 Vrms 380 Vrms 400 Vrms	F,G	5 or 6 7 10 10	50 Hz
Israel	230 Vrms 400 Vrms	C,D,J	7 10	50 Hz
Italy	127 Vrms 220 Vrms 380 Vrms	C,F	1, 2, 13, or 14 5 or 6 10	50 Hz
Ivory Cost	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
Jamaica	110 Vrms 220 Vrms	A,B	1, 2, 13, or 14 5 or 6	50 Hz
Japan	100 Vrms 200 Vrms	A	1, 2, 13, or 14 3 or 4	50/60 Hz
Jordan	220 Vrms 380 Vrms	C,F,G	5 or 6 10	50 Hz
Kenya	240 Vrms 415 Vrms	D,G	7 10	50 Hz
North Korea	220 Vrms 380 Vrms	A,F	5 or 6 10	not avail.

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
South Korea	100 Vrms 200 Vrms 240 Vrms 415 Vrms	A,F	1, 2, 13, or 14 3 or 4 7 10	60 Hz
Laos	220 Vrms 380 Vrms	A,C	5 or 6 10	50 Hz
Lebanon	110 Vrms 190 Vrms 220 Vrms 380 Vrms	C	1, 2, 13, or 14 3 or 4 5 or 6 10	50 Hz
Lesotho	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
Liberia	120 Vrms 208 Vrms 240 Vrms 416 Vrms	A,G	1, 2, 13, or 14 3 or 4 7 10	60 Hz
Libya	127 Vrms 220 Vrms 400 Vrms	D	1, 2, 13, or 14 5 or 6 10	50 Hz
Luxembourg	120 Vrms 208 Vrms 220 Vrms 380 Vrms	C,F	1, 2, 13, or 14 3 or 4 5 or 6 10	50 Hz
Malawi	230 Vrms 400 Vrms	G	7 10	50 Hz
Malaysia	240 Vrms 415 Vrms	G	7 10	50 Hz
Mali	127 Vrms 220 Vrms 380 Vrms	C,E	1, 2, 13, or 14 5 or 6 10	50 Hz
Malta	240 Vrms 415 Vrms	G	7 10	50 Hz
Martinique	127 Vrms 220 Vrms	C,D,E	1, 2, 13, or 14 5 or 6	50 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Mauritania	220 Vrms	C	5 or 6	50 Hz
Mauritius	230 Vrms 400 Vrms	C,D,G	7 10	50 Hz
Mexico	127 Vrms 220 Vrms 277 Vrms 480 Vrms	A	1, 2, 13, or 14 5 or 6 8 or 9 11 or 12	60 Hz
Monaco	127 Vrms 220 Vrms 380 Vrms	C,D,E,F	1, 2, 13, or 14 5 or 6 10	50 Hz
Montserrat	230 Vrms 400 Vrms	A,B,G	7 10	60 Hz
Morocco	115 Vrms 220 Vrms 380 Vrms	C,D,E,F	1, 2, 13, or 14 5 or 6 10	50 Hz
Mozambique	220 Vrms	C,F	5 or 6	50 Hz
Nepal	220 Vrms 400 Vrms	D	5 or 6 10	50 Hz
Netherlands	220 Vrms 380 Vrms	C,F	5 or 6 10	50 Hz
Nicaragua	120 Vrms 240 Vrms	A	1, 2, 13, or 14 7	60 Hz
Niger	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
Nigeria	220 Vrms 230 Vrms 380 Vrms 400 Vrms	D,G	5 or 6 7 10 10	50 Hz
Norway	220 Vrms 380 Vrms	C,F	5 or 6 10	50 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Oman	240 Vrms 415 Vrms	D,G	7 10	50 Hz
Pakistan	230 Vrms 400 Vrms	C,D	7 10	50 Hz
Panama	120 Vrms 240 Vrms 277 Vrms 480 Vrms	A,B	1, 2, 13, or 14 7 8 or 9 11 or 12	60 Hz
Paraguay	220 Vrms 380 Vrms 440 Vrms	C	5 or 6 10 11 or 12	50 Hz
Peru	225 Vrms	A	5 or 6	60 Hz
Philippines	110 Vrms 220 Vrms	A,B,C,D,J	1, 2, 13, or 14 5 or 6	60 Hz
Poland	220 Vrms 380 Vrms	C,E,F	5 or 6 10	50 Hz
Portugal	220 Vrms 380 Vrms	C,D	5 or 6 10	50 Hz
Puerto Rico	120 Vrms 240 Vrms 480 Vrms	A,B	1, 2, 13, or 14 7 11 or 12	60 Hz
Qatar	240 Vrms 415 Vrms	D,G	7 10	50 Hz
Rumania	220 Vrms 380 Vrms	C,F	5 or 6 10	50 Hz
Rwanda	220 Vrms 380 Vrms	C,J	5 or 6 10	50 Hz
St. Lucia	240 Vrms 415 Vrms	G	7 10	50 Hz
St. Vincent	230 Vrms 400 Vrms	G	7 10	50 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Saudi Arabia	127 Vrms 220 Vrms 380 Vrms	A,B,C,D,E,F,G	1, 2, 13, or 14 5 or 6 10	50/60 Hz
Senegal	127 Vrms 220 Vrms	C,F	1, 2, 13, or 14 5 or 6	50 Hz
Seychelles	240 Vrms	D,G	7	not avail.
Sierra Leone	230 Vrms	D,G	7	50 Hz
Singapore	230 Vrms 400 Vrms	C,G	7 10	50 Hz
Somalia Rep.	110 Vrms 220 Vrms 440 Vrms	C,D	1, 2, 13, or 14 5 or 6 11 or 12	50 Hz
South Africa	220 Vrms 250 Vrms 380 Vrms 400 Vrms 433 Vrms 500 Vrms	D	5 or 6 7 10 10 10 11 or 12	50 Hz
Spain	127 Vrms 220 Vrms 380 Vrms	C,E	1, 2, 13, or 14 5 or 6 10	50 Hz
Sri Lanka	230 Vrms 400 Vrms	D	7 10	50 Hz
Sudan	240 Vrms 415 Vrms	C,F,G	7 10	50 Hz
Suriname	115 Vrms 127 Vrms 220 Vrms	C,F	1, 2, 13, or 14 1, 2, 13, or 14 5 or 6	60 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
Swaziland	230 Vrms 400 Vrms	D	7 10	50 Hz
Sweden	220 Vrms 380 Vrms	C,F	5 or 6 10	50 Hz
Switzerland	220 Vrms	C,F	5 or 6	50 Hz
Syria	115 Vrms 200 Vrms 220 Vrms 380 Vrms	C	1, 2, 13, or 14 3 or 4 5 or 6 10	50 Hz
Taiwan	110 Vrms 220 Vrms 380 Vrms	A,B,H,I,J	1, 2, 13, or 14 5 or 6 10	60 Hz
Tanzania	230 Vrms 380 Vrms	D,G	5 or 6 10	50 Hz
Thailand	220 Vrms 380 Vrms	A,C	5 or 6 10	50 Hz
Togo	220 Vrms 380 Vrms	C,E	5 or 6 10	50 Hz
Tonga	110 Vrms 240 Vrms 415 Vrms	D,I	1, 2, 13, or 14 7 10	50 Hz
Trinidad/ Tobago	115 Vrms 230 Vrms 400 Vrms	A,B,D,G,I	1, 2, 13, or 14 7 10	60 Hz
Tunisia	220 Vrms 380 Vrms	C	5 or 6 10	50 Hz
Turkey	220 Vrms 380 Vrms	C,E,F	5 or 6 10	50 Hz
Uganda	240 Vrms	G	7	50 Hz

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Country	Nominal Voltage	Applicable Plug Type	Main Channel Setup Number	Line Frequency
United Arab Emirates	220 Vrms 380 Vrms 400 Vrms	D,G	5 or 6 10 10	not avail.
United Kingdom	240 Vrms 415 Vrms	C,G	7 10	50 Hz
Upper Volta	220 Vrms	C	5 or 6	50 Hz
Uruguay	220 Vrms	C,I	5 or 6	50 Hz
USSR	127 Vrms 220 Vrms 380 Vrms	C,I	1, 2, 13, or 14 5 or 6 10	not avail.
Venezuela	120 Vrms 208 Vrms 380 Vrms	I,J	5 or 6 3 or 4 10	60 Hz
Western Samoa	230 Vrms	(No Info)	7	50 Hz
Yemen (Arab Rep.)	220 Vrms	C,D	5 or 6	50 Hz
Yemen	250 Vrms 440 Vrms	A,D	7 11 or 12	50 Hz
Yugoslavia	220 Vrms 380 Vrms	C,F	5 or 6 10	50 Hz
Zaire	220 Vrms 380 Vrms	E	5 or 6 10	50 Hz
Zambia	230 Vrms 400 Vrms	G	7 10	50 Hz
Zimbabwe	220 Vrms	D,G	5 or 6	50 Hz

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TM-113807

CABLE SETS FOR THE 656 DISTURBANCE WAVEFORM ANALYZER

(Not Applicable with the 656A)

31 December 1988

HAWKER DRANETZ SIDDELEY

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Figure 1. Cable Set 113807

(Cable Set 113806 only contains P/N 110847-G2 & P/N 113805-G1)

INTRODUCTION

This manual contains the installation instructions for the two 656 cable sets (these sets are intended for use with the 656 and will not work with the 656A):

- Set 113806, 656 4-Channel Cable set
- Set 113807, 656 Universal Cable set

These sets provide the cables required for connecting the 656 Main channels to the lines being monitored. The contents of each set is described below.

CABLE SET CONTENTS

Set 113806

This set contains 8 cables:

- Four (4) 656 AC cables (P/N 113805-G1)
- Four (4) 3-wire cables (P/N 110487-G2)

Set 113807 (Illustrated in Figure 1)

This set contains 11 cables:

- Four (4) 656 AC cables (P/N 113805-G1)
- Four (4) 3-wire cables (P/N 110487-G2)
- A wye cable with separate safety ground wire (P/N 113853-G1)
- A delta cable with separate safety ground wire (P/N 113852-G1)
- A single phase (1ϕ) cable with separate safety ground wire (P/N 113854-G1)

CABLE SET VERIFICATION

Check the set you have received to be sure it contains all of the applicable contents listed above. If any of the cables are damaged or missing, contact Dranetz Customer Service Dept. for further instructions:

Tel: (201) 287-3680
FAX: (201) 248-9240
TWX: (710) 997-9553
TELEX: 499-7808
CABLE: DRANETZ

WIRING THE 656 MAIN CHANNELS FOR AC INPUTS

WARNING

Connection should be performed ONLY be qualified personnel. At the time of this writing, Underwriters Laboratories has determined that the qualifications for performing electrical connections are self-determined by the person performing the task.

The cables in your set are approved for use on branch circuits of up to 20 amperes. These cables exceed the minimum flexible cord size of 1 mm square (No. 18). For branch circuits of higher amperage, refer to the National Electric Code, ANSI CI-1975, Paragraphs 2404-4 and 250-95. Refer to Article 250 of the National Electric Code if you are in doubt. Outside the U.S., consult the applicable safety standards.

The 656 has four Main channel inputs. Each input consists of a barrier type terminal strip located beneath a safety cover. To wire each of the Main channel inputs, proceed as follows:

1. Turn off the 656 but leave its power cord plugged in to maintain a safety ground.

2. Turn off the power to the line(s) to be monitored.

3. Remove the safety cover of the barrier strip you are going to wire. (Only remove the one you are currently working on.)

4. Connect cable 113805-G1 to the barrier strip as illustrated in Figure 2 below:

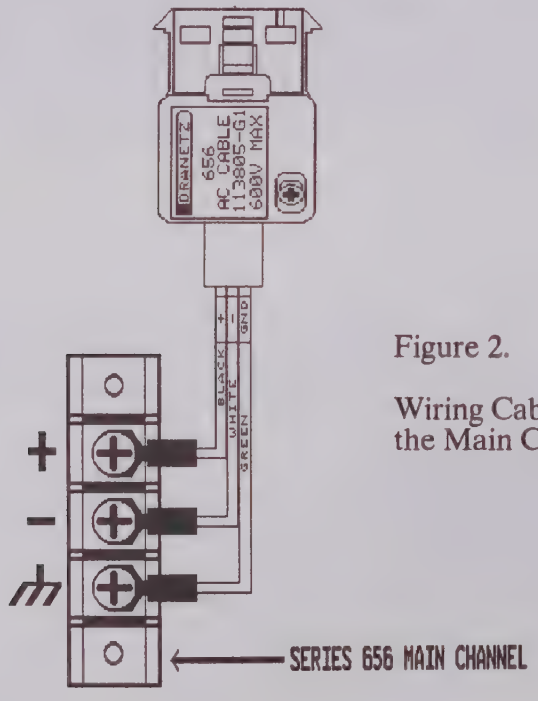


Figure 2.

Wiring Cable 113805-G1 to the Main Channels

5. Replace the safety cover of the barrier strip you have just wired.
6. Repeat steps 3 through 5 for all remaining channels.
7. Verify that all safety covers are back in place.

CAUTION

To avoid damaging the 656, DO NOT apply voltages exceeding 600 V rms to any of its inputs.

CIRCUIT CONNECTION GUIDELINES FOR THE MAIN CHANNELS

Proper monitoring and analysis of ac and dc voltage disturbances requires careful attention to the method of connection between the 656 Main channels and the monitored circuits. To obtain the most accurate and relevant voltage monitoring data, you should adhere to the following guidelines:

- Be aware that frequency information is primarily measured on channel A, therefore, never connect channel A from Neutral-to-Ground. If channel A fails, frequency information is measured on channel B; if channel B fails, it's measured on channel C.
- As a convention, always connect channel D from Neutral-to-Ground unless you are monitoring dc inputs.
- The instrument safety ground input is internally tied to the 656 frame ground which then connects to its line cord earth ground. To avoid filtering out the disturbances you are trying to capture, whenever possible you should power the 656 from a separate line than the one you are monitoring.
- If you are monitoring a power line connected to critical, sensitive load equipment, connect the cables to the power line as close as possible to the load. For 3ϕ loads, connect the 656 in the same way as the load equipment (Line-to-Line, Line-to-Neutral, and so forth).

MAIN CHANNEL CIRCUIT APPLICATIONS

- The 656 can monitor Neutral-to-Ground and Line-to-Neutral voltage in a 120V ac 1ϕ system (Figure 3). This application uses two of the four Main channels (A and D in the illustration).
- The 656 can monitor Normal and Common mode voltage in a 120V ac single phase (1ϕ) system (Figure 4).

- The can monitor Line A-to-Neutral, Line B-to-Neutral, and Neutral-to-Ground voltages in a 120V ac split-phase system, while also monitoring Line A-to-Line B voltage in a 240V ac split-phase system (Figure 5). This application uses all four Main channels.

- The 656 can monitor Line A-to-Neutral, Line B-to-Neutral, Line C-to-Neutral, and Neutral-to-Ground voltages in a 3ϕ "wye" system (Figure 6). This application uses all four Main channels.

- The 656 can monitor Line A-to-Line B, Line B-to-Line C, and Line A-to-Line C voltages in a 3ϕ "delta" system (Figure 7). This application uses three of the four Main channels (A, B, and C in the illustration).

- The 656 can monitor up to three dc inputs using Main channels B, C, and D. For this configuration, Main channel A should be set up to monitor Line A-to-Neutral voltage (Figure 8).

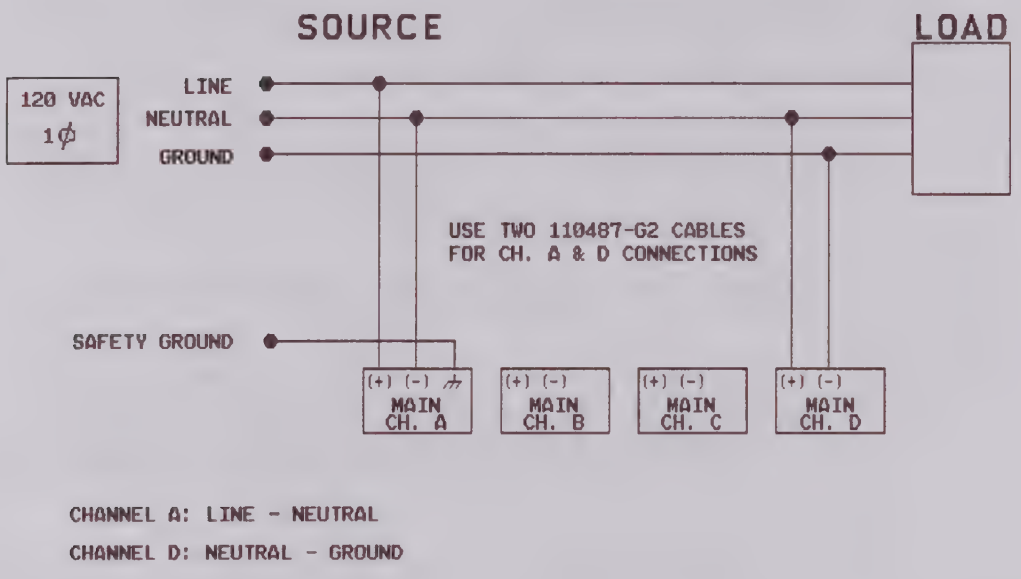


Figure 3. 120V AC 1ϕ Connections

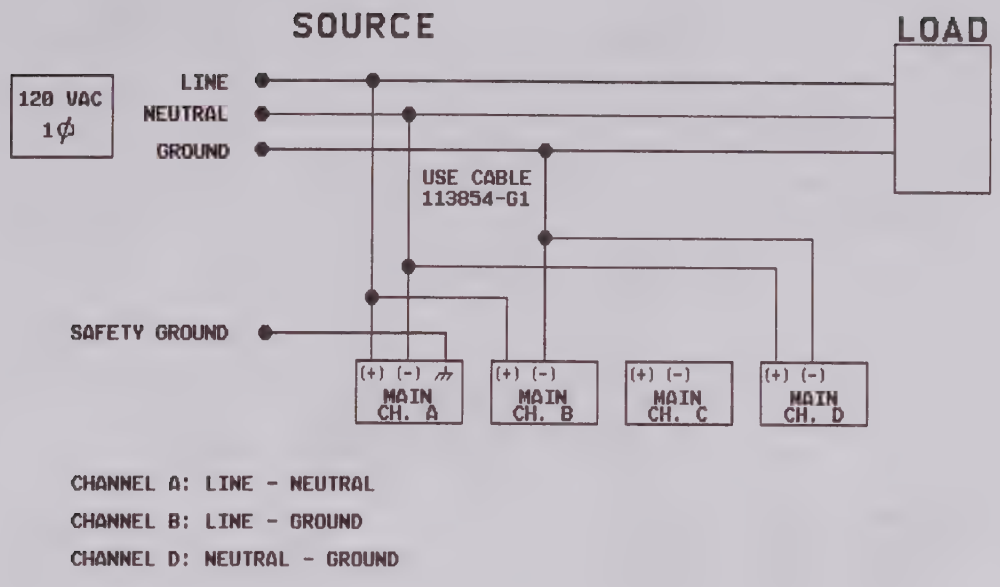


Figure 4. Single Phase (1ϕ) Normal and Common Mode Connections

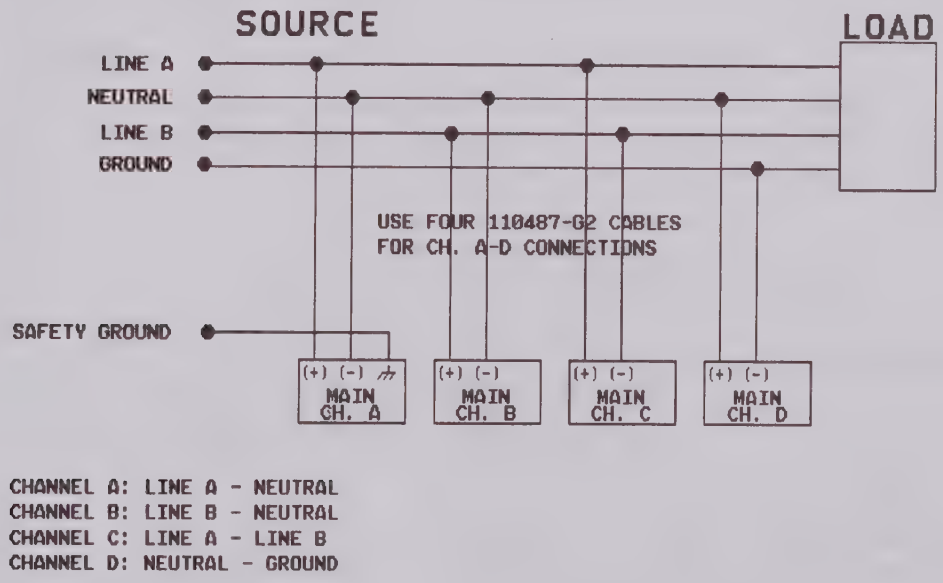


Figure 5. 120V/240V AC Split-Phase Connections

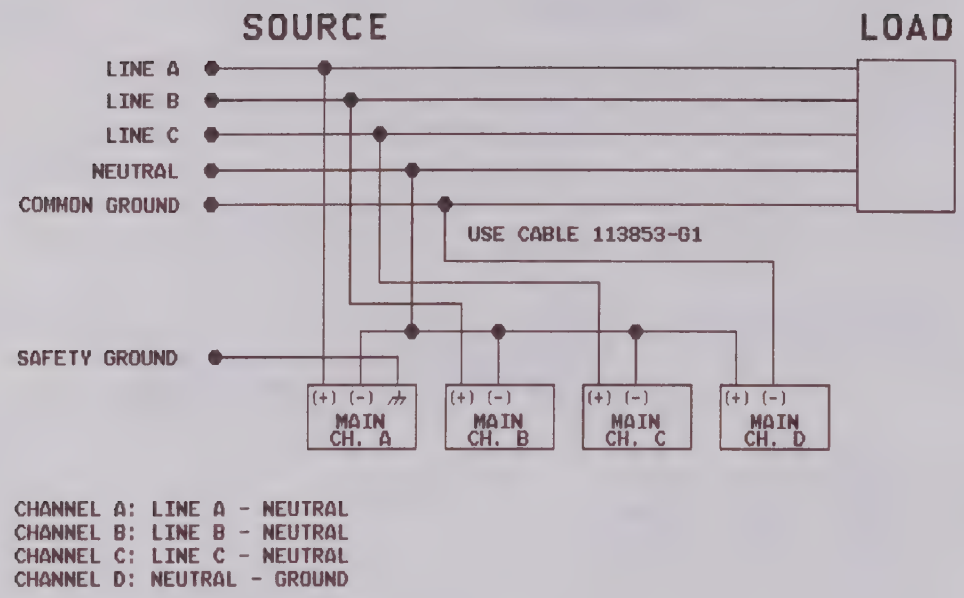


Figure 6. 3ϕ "Wye" Connections

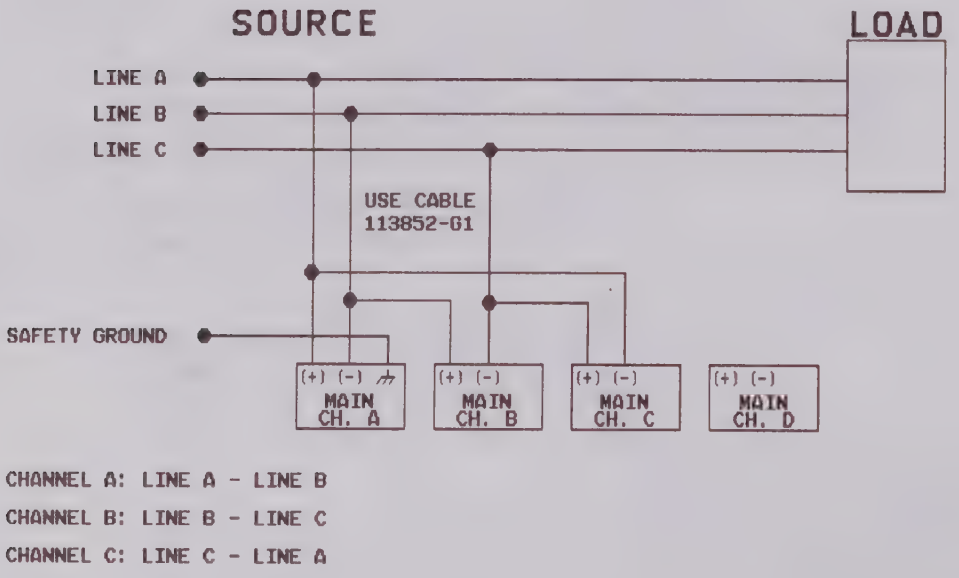
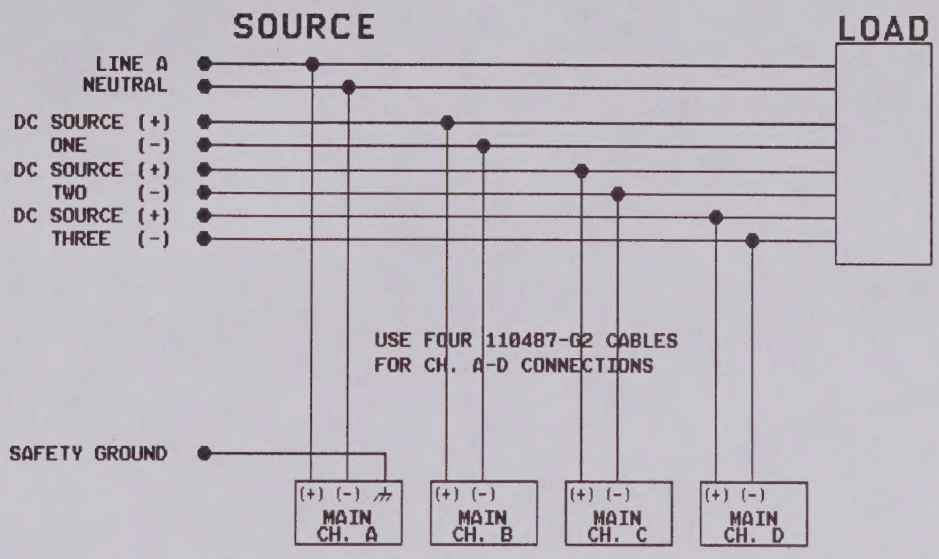


Figure 7. 3ϕ "Delta" Connections



CHANNEL A: LINE A - NEUTRAL
CHANNEL B: DC SOURCE ONE
CHANNEL C: DC SOURCE TWO
CHANNEL D: DC SOURCE THREE

Figure 8. Typical 3-Source DC Input Connections

Below is an example of the Main Channel Setups Screen that corresponds to the above configuration:

```
1 Setup #16 A      B      C      D
2 Range     VH     VL     VL     VL


6 Imp.     1000 100.0 050.0 200.0
7 Wave      002  02.0  05.0  02.0
8 Frequency   0.5 (All Channels)
(A)ctivate (P)rint e(X)it (H)elp
```

NOTE

Voltage thresholds are set for ac rms changes. For dc changes, you must remove the rms factor of 1.414 (square root of 2). You must take the dc voltage setting you want, divide it by 1.414, and set it equal to the nearest integer value in the Main Channel Setups. For example: If you want 3V dc as the trip point, set the threshold to $3 \div 1.414 \approx 2$ *(as in all four channels of the above example).*

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